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Use of Abandoned Strip Mines for Disposal of Solid Waste in Maryland

Maryland Dept of Health and Mental Hygiene, Baltimore

Prepared for

Environmental Protection Agency, Washington, D C Office of Solid Waste Management Programs

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USE OF ABANDONED STRIP MINES

For Disposal Of Solid Waste In Maryland

Maryland Dept. Of Health & Mental Hygiene

ENVIRONMENTAL HEALTH ADMINISTRATION

Division Of Solid Waste Control

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USE OF ABANDONED STRIP MINES FOR SOLID WASTE DISPOSAL IN MARYLAND

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Management Programs

Maryland Department of Health and Mental Hygiene
Environmental Health Administration
Division of Solid Waste Control

June, 1973

STATE OF MARYLAND
THE HONORABLE MARVIN MANDEL
GOVERNOR

* * *

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Special recognition is given to Mr. Robert Turner, Landfill Supervisor, and his entire crew, for their dedicated service, under many trying emergencies without which this project would not have been successful.

ACKNOWLEDGEMENTS TO FORMER PROJECT PARTICIPANTS

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FOREWARD

This report is the product of the work performed under Grant No. GO6-EC-0048 from the Office of Solid Waste Management Programs to the State of Maryland Department of Health and Mental Hygiene, Division of Solid Waste Control. It has been reviewed by the U.S. Environmental Protection Agency. Publication does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of commercial products or processes constitute endorsement or recommendation for use by the U.S. Government. The report is reproduced as it was submitted to the Environmental Protection Agency. The Environmental Protection Agency is not responsible for technical or editorial inaccuracies.

by

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SOLID WASTE MANAGEMENT PROGRAM

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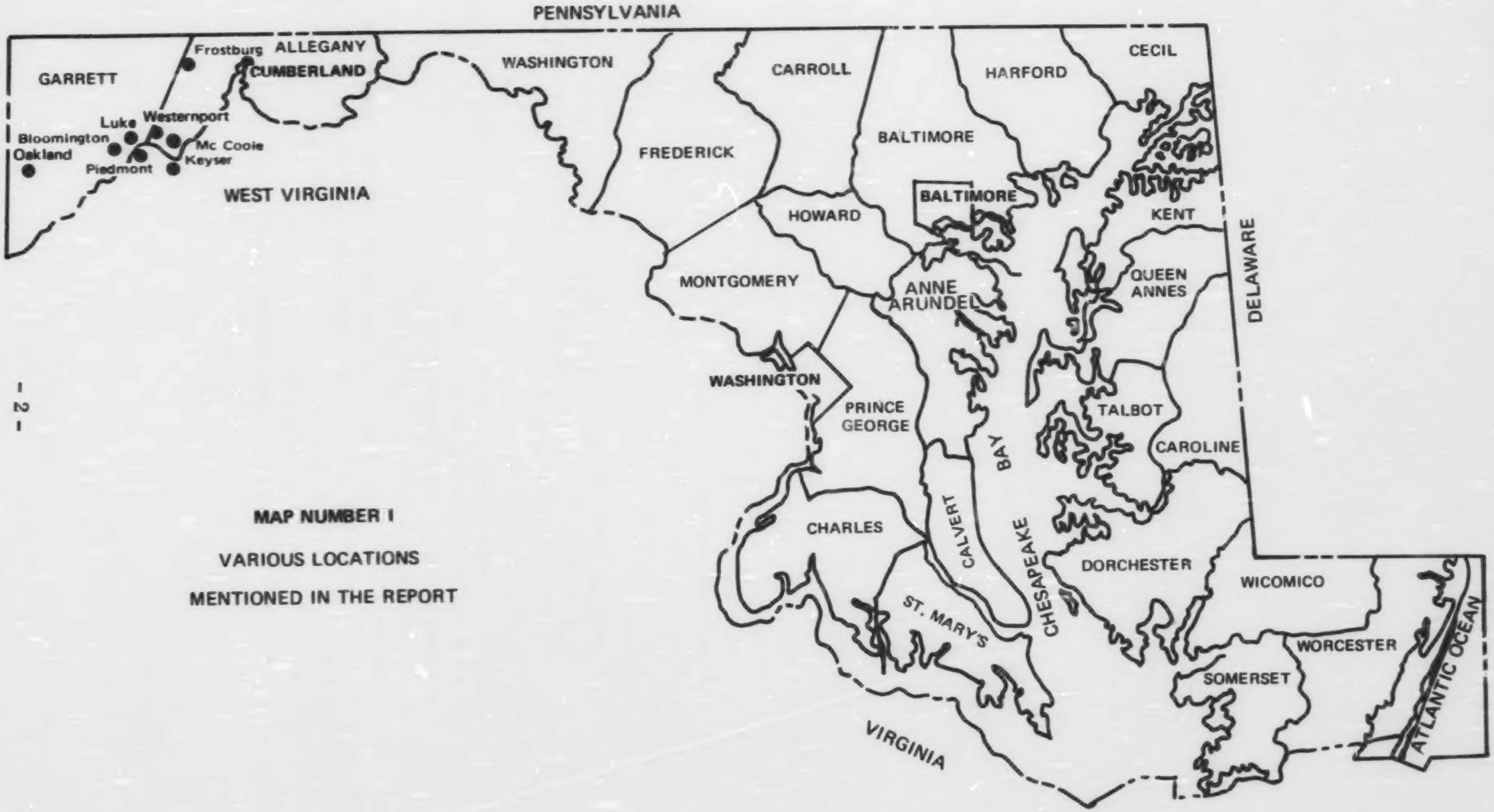
SUMMARY

This demonstration project was devised to determine the feasibility of using abandoned coal strip mines for the disposal of solid wastes by sanitary landfilling. Two sites were ultimately selected and used. Frostburg Site Number 1 served from the beginning of the project in the early part of 1967 and was terminated on October 31, 1971. Westernport Site Number 2 operated from the latter part of 1968 to October 1969, and served the two-fold purpose of studying the effect of different types of solid waste on acid mine water as well as fulfilling a regional concept of solid waste management for the two-state, three-county area (see Map Number 1 for the general location of the project).

With the completion of the first studies on the acid mine drainage filter bed system in 1969, federal funding for the original Westernport regional landfill project was terminated and the disposal operation was relocated to an adjacent, abandoned strip mine, which is now operated by Allegany County. Additional contact filter beds of industrial wastes were federally funded for the remaining two years at Westernport and were completed in October 1971. With the termination of the major Demonstration Project at Frostburg Site Number 1, Allegany County relocated this disposal operation to another abandoned strip mine site and continued its operation.

As a result of the Demonstration Project, the use of abandoned strip mines for solid waste disposal has proven to be both technically and economically feasible. Chemical and bacteriological studies indicate that no public health problems will be experienced from the proper landfilling of solid wastes in strip mines. The experience of the Frostburg project allowed an operating cost of $1.45 per ton to be developed for the disposal of an average of 235 tons per day. This disposal cost is lower than normally encountered for operations of a similar size on land other than abandoned strip mines. The use of abandoned strip mines for solid waste disposal has shown that the land-use costs are either low or nonexistant; that excavation of the disposal pit has previously been accomplished; that access roads previously used to remove coal to market are now available for use as delivery roads for solid waste; that cover material is either close to or at the fill face; and

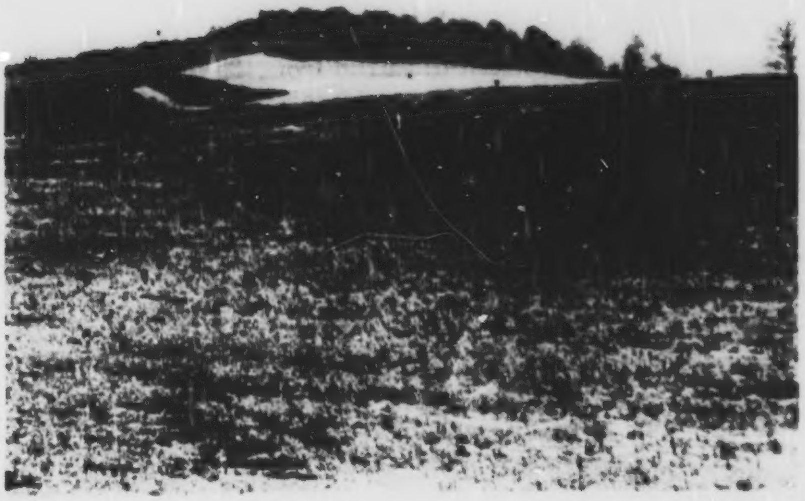

PENNSYLVANIA
GARRETT
Frostburg
ALLEGANY
CUMBERLAND
WASHINGTON
CARROLL
HARFORD
CECIL
Luke
Westernport
Bloomington
Mc Coole
Oakland
Piedmont
Keyser
WEST VIRGINIA
FREDERICK
BALTIMORE
BALTIMORE
HOWARD
KENT
MONTGOMERY
ANNE ARUNDEL
QUEEN ANNES
DELAWARE
WASHINGTON
PRINCE GEORGE
TALBOT
BAY
CAROLINE
CHARLES
CALVERT
CHESAPEAKE
DORCHESTER
WICOMICO
ST. MARY'S
WORCESTER
SOMERSET
ATLANTIC OCEAN
VIRGINIA

MAP NUMBER I

VARIOUS LOCATIONS

MENTIONED IN THE REPORT

that offsite drainage often already exists and needs only minor modification. These and other similar desirable features serve to reduce the total refuse disposal cost.



Picture No. 1 Frostburg Site Number 1 showing filled and revegetated area in the background

The operating procedures employed on these projects are similar to those used in the area method of sanitary landfilling and require no significant modifications. The volumetric refuse cover ratio of 4:1 used was reasonable for sanitary landfilling and was accomplished by using six-foot lifts of refuse, six inches of daily cover, and from three to five feet of final cover. A final cover slope of two to three percent and normal compaction procedures reduced completed fill maintenance to a minimum.

In addition to proving the feasibility of sanitary landfilling solid wastes in abandoned strip mines, methods were developed to allow continuing collection of hydrogeological, chemical, microbiological and settlement data. Methods were also devised and preliminary data were collected for checking the pH corrective capabilities of solid waste on acid mine water. Further study will be required before definite conclusions can be drawn from this part of the project, but the methods used are believed to be valid.

The total area benefits gained from the project were the development of an acceptable sanitary solid waste disposal system on a regional interstate basis; the gaining of public acceptance of sanitary landfilling operated to protect the public health; restoration of a landscape ravaged by strip mining of coal; elimination of many haphazardly located open refuse dumps; provision of gainful employment for citizens previously receiving welfare benefits; reduction of acid mine drainage; and the general satisfaction of accomplishing a degree of environmental restoration.

CHAPTER I

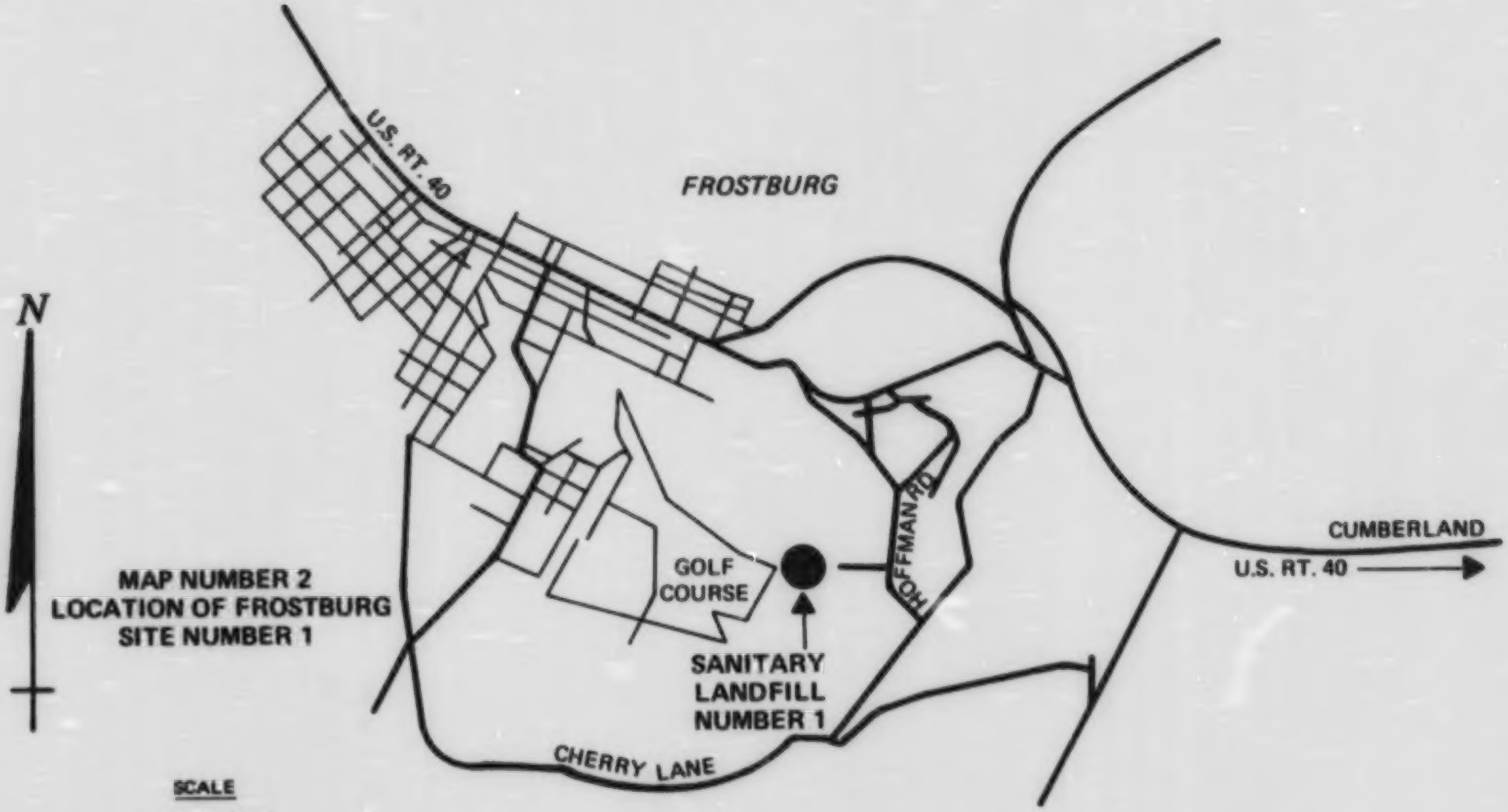
INTRODUCTION

The Maryland State Department of Health and Mental Hygiene, hereinafter referred to the "Department", was established for and has been charged by the Maryland General Assembly with protecting the health and welfare of the citizens of the State. This protection takes on many forms and varies with the needs of any particular community. It has ranged from straight regulatory control to providing technical assistance in actual facility development and operations.

While solid waste management historically came under the jurisdiction of the Department, the Federal Solid Waste Disposal Act of 1965 with its associated funding, provided the impetus for a higher degree of planning and technical assistance throughout the State. Later, the General Assembly enacted legislation requiring that solid waste disposal plans be developed for Baltimore City and the counties of the State. This task became the responsibility of the Department's Division of Solid Waste Control.

A problem area in which it was readily apparent that refuse disposal assistance should be extended was the town of Frostburg, Maryland and its influence area. The area has a population of about 15,000 people, is located approximately 9 miles west of Cumberland in Allegany County and is the home of Frostburg State College. Map Number 2 shows the location of Site Number I with relation to Frostburg. The refuse generated in the town and surrounding area was being burned on an open dump near the college campus. This was not only a source of pollution and local nuisance, but the dump was also scheduled for abandonment to allow much needed expansion of the college campus.

In studying the Frostburg problem, representatives of the Department decided to investigate the feasibility of reclaiming abandoned strip coal mines with solid waste fill. They recognized this concept as not only a possible solution to the local solid waste and abandoned strip mine problems, but also one which could have far-reaching application at any location in the country where abandoned surface mines exist. Maryland offered maximum flexibility in site selection since it has over 2,300 abandoned strip mines in its two westermost counties. All of these had been previously provided with access roads for mining equipment and for the removal of the mined coal to market. One mine pit was particularly attractive for Frostburg since it was within two miles of the center of town, yet it was believed to be capable of being used for a sanitary landfill without causing a public health problem or nuisance.

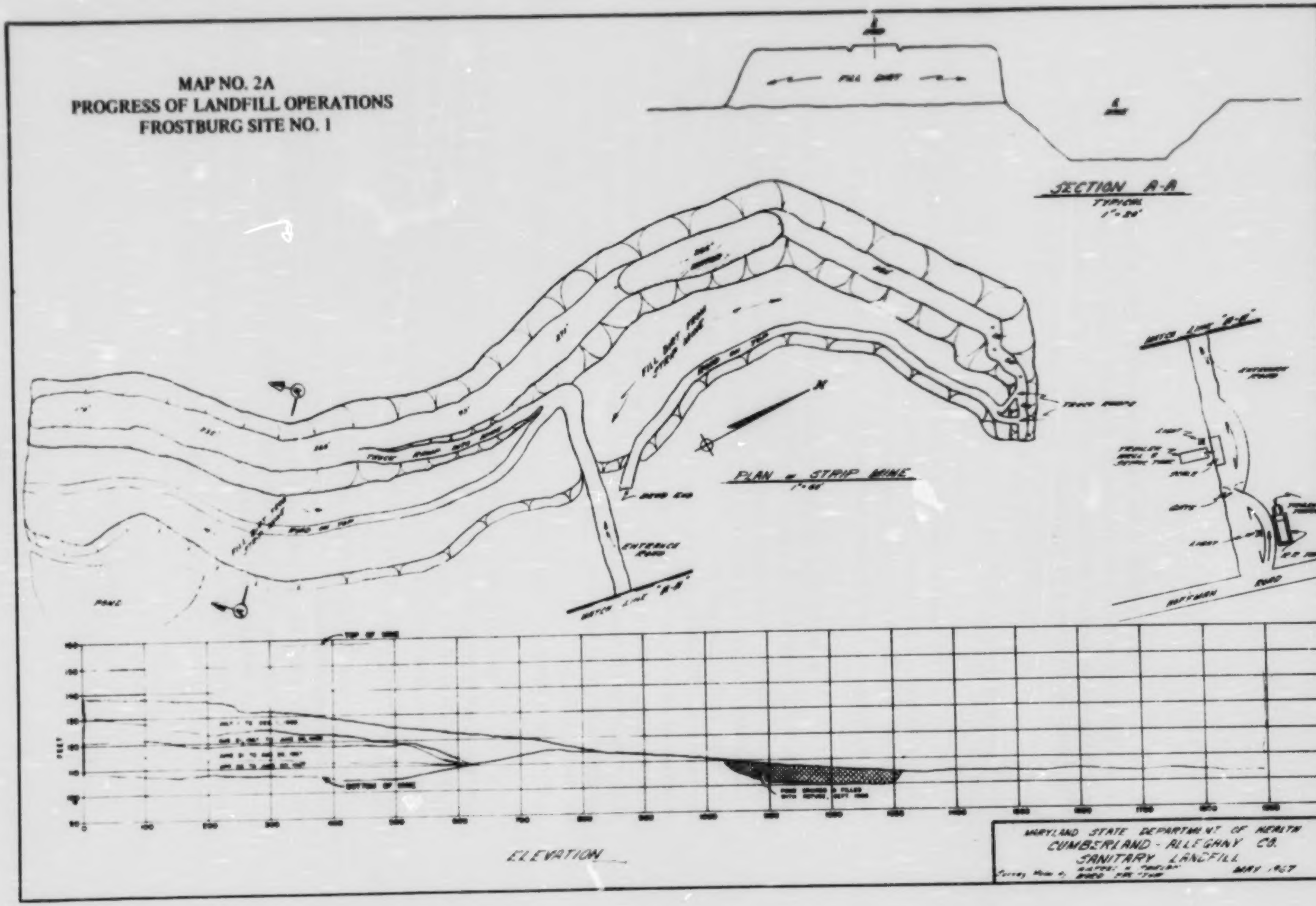

FROSTBURG
U.S. RT. 40
HOFFMAN RD
GOLF COURSE
SANITARY LANDFILL NUMBER 1
CHERRY LANE
CUMBERLAND
U.S. RT. 40
N

MAP NUMBER 2
LOCATION OF FROSTBURG
SITE NUMBER 1

SCALE

NOT TO SCALE

MAP NO. 2A
PROGRESS OF LANDFILL OPERATIONS
FROSTBURG SITE NO. 1


FILL DIRT
SECTION A-A
TYPICAL
1" = 20'
PLAN – STRIP MINE
FILL DIRT FROM STRIP MINE
ROAD ON TOP
TRUCK RAMP
DEAD END
ENTRANCE ROAD
MATCH LINE "B-B"
POND
LIGHT
SCALE
GATE
HOFFMAN ROAD
TOP OF MINE
BOTTOM OF MINE
FEET
ELEVATION
MARYLAND STATE DEPARTMENT OF HEALTH
CUMBERLAND - ALLEGANY CO.
SANITARY LANDFILL
MAY 1967

As a result of the foregoing study, the Department applied for a Federal grant to demonstrate that the concepts developed might be applied to solid waste management problems in other areas of the county. The grant application was approved, and the project began in November 1966.

SCOPE OF PROJECT.

Two major considerations were involved in deciding to landfill abandoned strip mines. The immediate consideration was that of locating a disposal site for solid waste for the Frostburg area, but just as important was the long range concern to environmentally restore the strip-mined land.

A strip coal mine is created when a layer of usable coal is located close enough to the surface of the ground to make it economically feasible to uncover with high capacity excavating machinery. Until recently, mine operators had no responsibility to restore stripped sites, so trenches with high adjacent stockpiles of excavated earth overburden were left to mar the landscape throughout strip mining areas. The environment was further marred when rainwater came into contact with the spoil piles and ponded in the mined trench. The water picked up soluble chemicals in the earth and created acid water which readily found its way to surface streams and destroyed the normal ecological balance. Filling and grading the abandoned pits is necessary to restore the land and reduce the acid mine water problem. Any acid water correction during the filling process would be an added benefit.

As with all properly designed sanitary landfills, a beneficial use of filled land is important if further environmental degradation is to be avoided. A reasonable final land use for the Demonstration Project area was recreation since the location offered a full range of capabilities from playing fields to a stocked fishing pond to the possible expansion of an adjacent golf course.

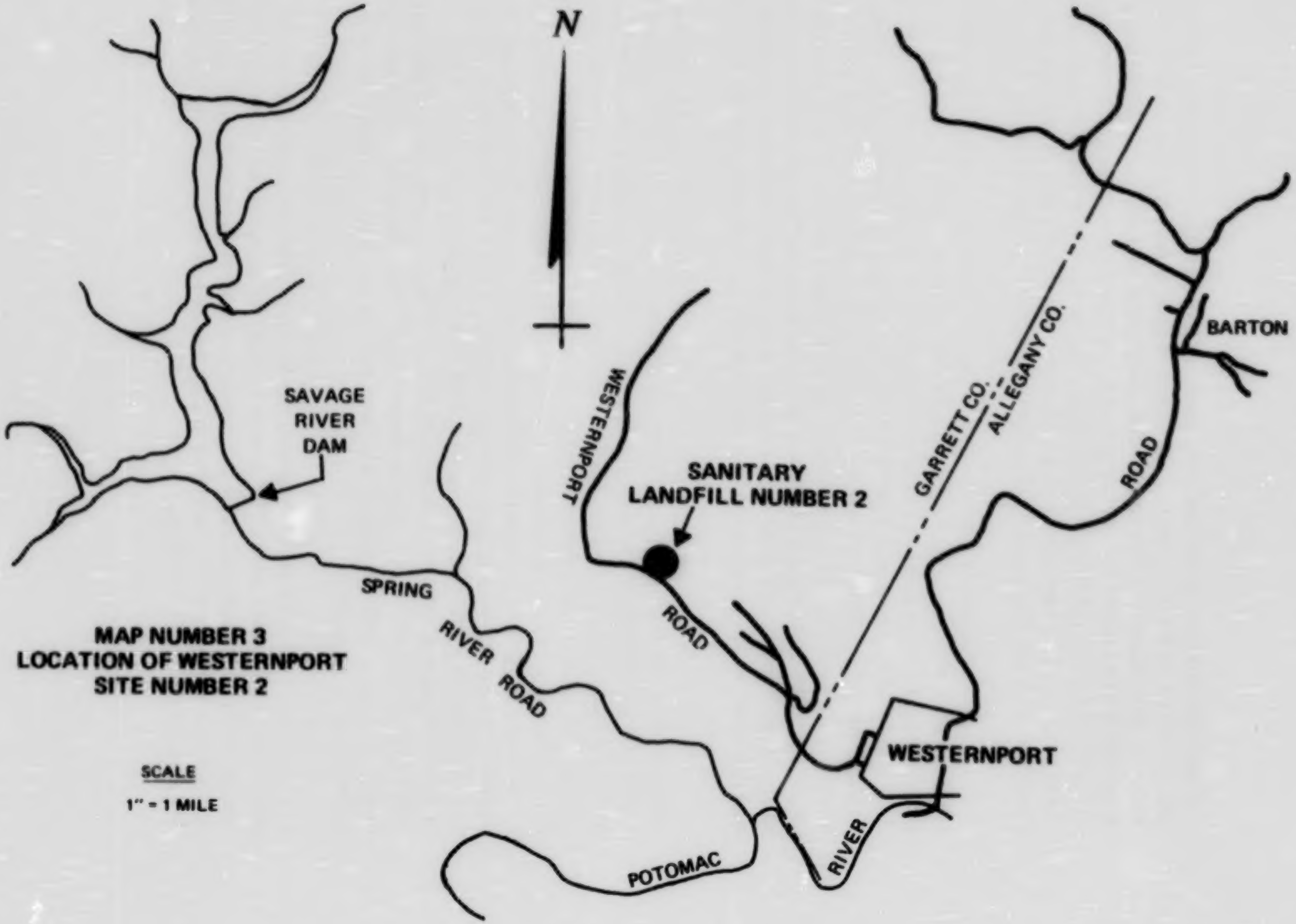
Although the project was originally established to prove the feasibility of a sanitary landfill operation for Frostburg and the surrounding semi-urban area of Allegany County, it was ultimately expanded to cover several political jurisdictions, and this required that a second mine disposal site also be established near Westernport by the end of the second year of the project. Ultimately, the two sites served the disposal needs of the towns of Frostburg, Cumberland, Westernport, Luke, Bloomington, and surrounding areas in both Allegany and

Garrett Counties in Maryland, the towns of Keyser and Piedmont in the adjacent States of West Virginia, and some major industrial complexes. Again, refer to Map Number I for the locations of these places. This large refuse generating shed expanded the scope of the project to demonstrate what type of legislation and public education might be required for solid waste management project to be operated for a regional interstate refuse contribution area. Map No. 3 shows the specific location of landfill Site No. 2.

Before the demonstration project started, almost all solid wastes collected from the region was disposed of in open burning dumps operated by individual jurisdictions. Home owners without refuse collection service either delivered their refuse to large open burning dumps, or used smaller ones located haphazardly throughout the area. As soon as the demonstration sanitary landfill was established, the Allegany County Health Department cooperated with the Department by initiating a county-wide cleanup campaign which eliminated many of the open dumps. Closing these illegal dumps significantly increased the quantities of waste received at the demonstration sanitary landfill sites.

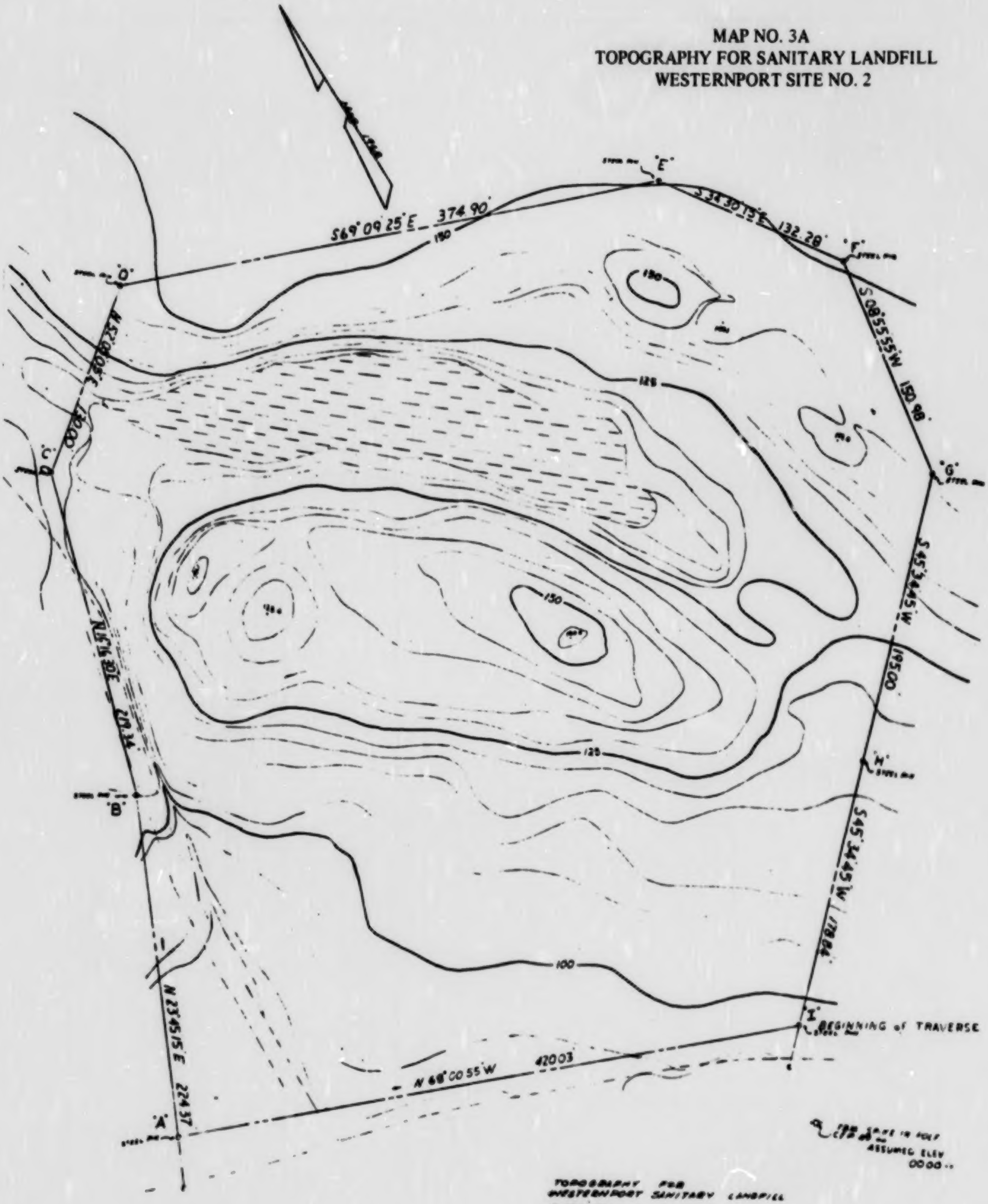
One of the most difficult tasks in establishing a proper disposal system in an area of previously haphazard dumps is planning for the various types and quantities of wastes encountered. The data collection system used at the demonstration project provided the background required for future solid waste management systems planning. As regional disposal practices were upgraded through the use of the demonstration sites, the quantity of waste received at the Frostburg site continually increased from an initial 20 to 60 tons per day during 1967 to 200 to 275 tons per day in 1971, with a 1971 average of approximately 235 tons per day. This information, reduced to a per capita generation and types of waste received, will be incorporated in any future sanitary landfill facility provided for the area. At the newer Westernport site, quantities increased from an initial 20 tons in 1968 to a final 100 tons per day in 1970. Graphs of quantities are shown in the Appendix.

Proper environmental protection legislation must be based on experience and feasible practices to accomplish its purpose effectively. The Demonstration Project allowed the Department staff to gain proper operating experience to review future operating plans and specifications better on solid waste projects proposed in the State.

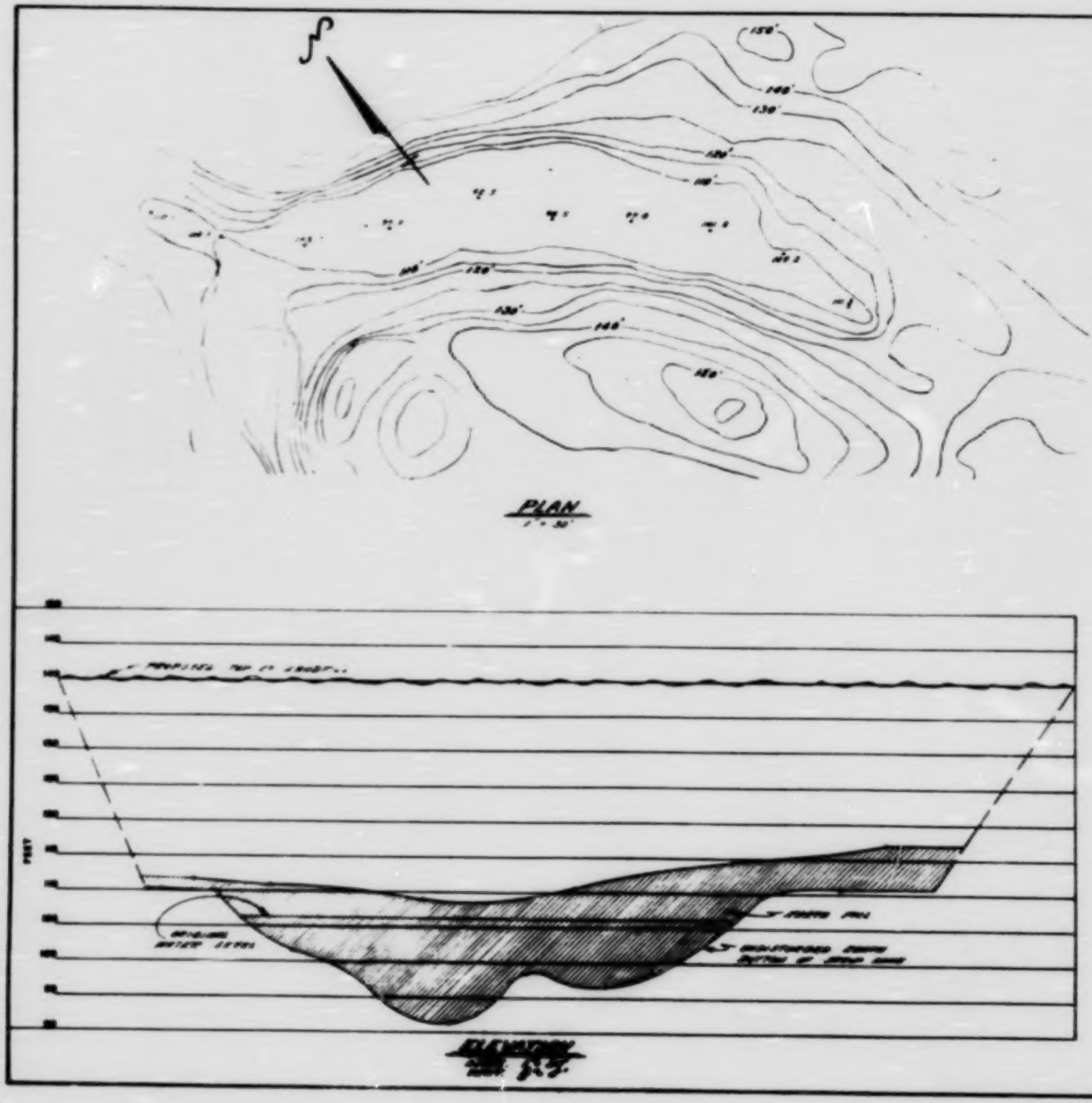

N
BARTON
ROAD
GARRETT CO.
ALLEGANY CO.
SANITARY
LANDFILL NUMBER 2
WESTERNPORT
ROAD
WESTERNPORT
RIVER
POTOMAC
SPRING
RIVER
ROAD
SAVAGE
RIVER
DAM
SCALE
1" = 1 MILE

MAP NUMBER 3
LOCATION OF WESTERNPORT
SITE NUMBER 2

MAP NO. 3A
TOPOGRAPHY FOR SANITARY LANDFILL
WESTERNPORT SITE NO. 2

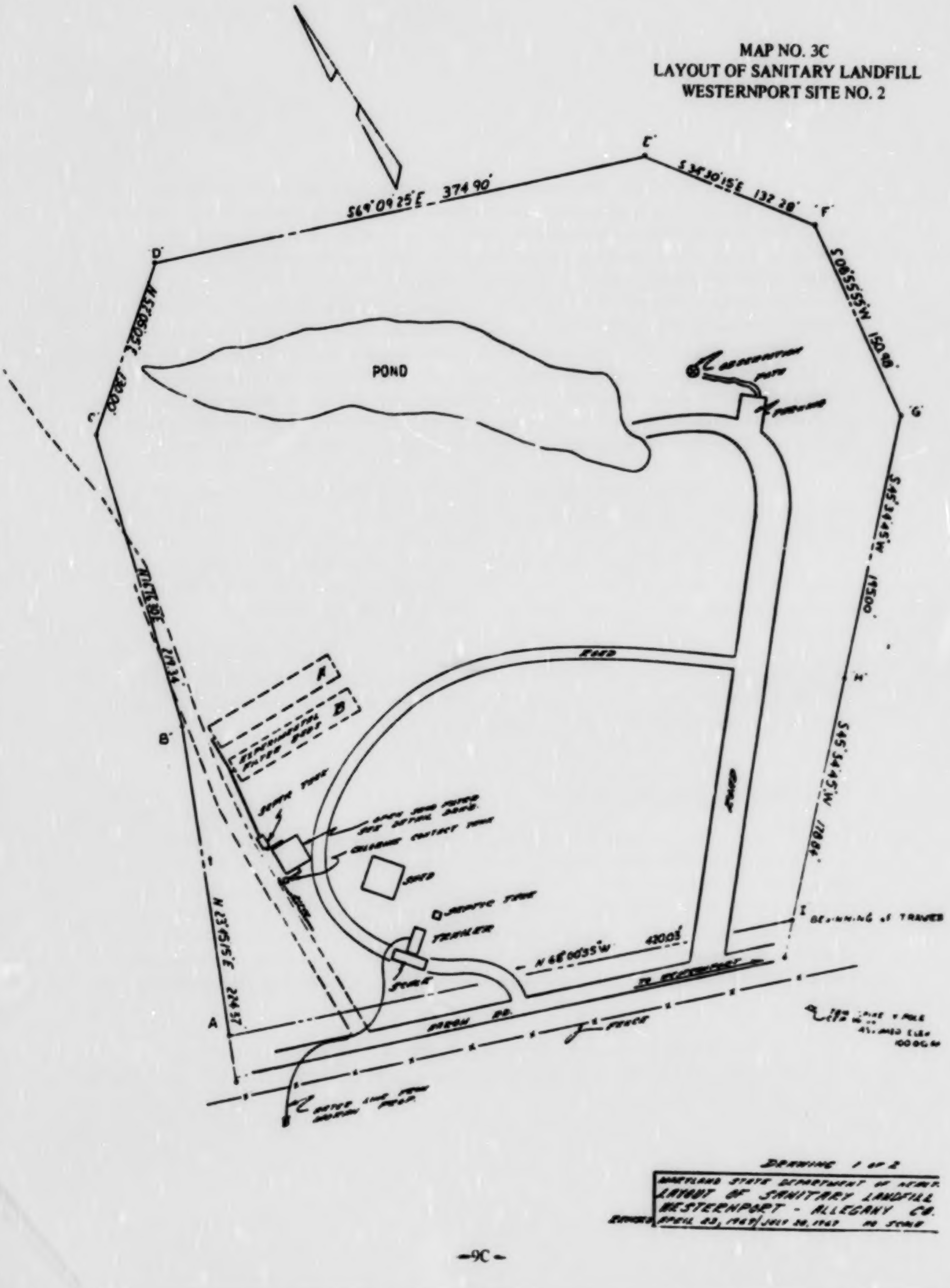

"D"
S69°09'25"E 374.90'
150
"E"
S34°30'15"E 132.28'
"F"
S08°55'55"W 150.98'
"G"
S45°34'45"W 195.00
"H"
S45°34'45"W 178.84
"I"
BEGINNING of TRAVERSE
100
125
150
N68°00'55"W 420.03
"A"
N23°45'15"E 224.37
"B"
"C"
ASSUMED ELEV
TOPOGRAPHY FOR
WESTERNPORT SANITARY LANDFILL

MAP NO. 3B
PLAN AND ELEVATION
WESTERNPORT SITE NO. 2


150'
140'
130'
120'
110'
130'
120'
130'
140'
150'
PLAN
1" = 30'
PROPOSED TOP OF LANDFILL
FEET
ORIGINAL WATER LEVEL
ELEVATION

MARYLAND STATE DEPARTMENT OF HEALTH
WESTERNPORT — ALLEGANY CO.
SANITARY LANDFILL SITE #2
PROFILE BY

MAP NO. 3C
LAYOUT OF SANITARY LANDFILL
WESTERNPORT SITE NO. 2


E'
S 69°09'25" E 374.90'
S 34°30'15" E 132.28'
F'
S 08°55'55" W 150.80'
G'
D'
N 35°09'35" E 100.00'
C'
POND
OBSERVATION PATH
PARKING
S 45°34'45" W 150.00'
H'
S 45°34'45" W 118.84'
ROAD
ROAD
A
B
EXPERIMENTAL FILTER BEDS
B'
N 23°16'35" E 243.14'
N 23°16'35" E 257.22'
SEPTIC TANK
OPEN SAND FILTER
SEE DETAIL DWG.
CHLORINE CONTACT TANK
SHED
SEPTIC TANK
TRAILER
SCALE
N 68°00'35" W 420.03'
I
BEGINNING OF TRAVERSE
TO WESTERNPORT
FENCE
ASSUMED ELEV. 1000.00
WATER LINE FROM
DRAWING 1 OF 2
MARYLAND STATE DEPARTMENT OF HEALTH
LAYOUT OF SANITARY LANDFILL
WESTERNPORT - ALLEGANY CO.
REVISED APRIL 23, 1969 / JULY 30, 1969 NO SCALE

The Water Resources Administration has the legal responsibility for the protection of ground and surface water quality in the State, and monitored the demonstration project from its inception. Before and when refuse was deposited on the sanitary landfill, eight preliminary water sampling points were located in the site vicinity as shown on Map No. 4. Sampling began early in 1967 to obtain background information on the water quality at those points and is still being continued. The results of the laboratory examinations of these samples (See Appendix) and additional information collected in the fourth and fifth years indicate that no significant changes in the water quality have occurred. Operating procedures were developed, as shown in the Appendix, to provide water quality safeguards which must be used by anyone disposing of solid wastes in abandoned strip mines in Maryland.

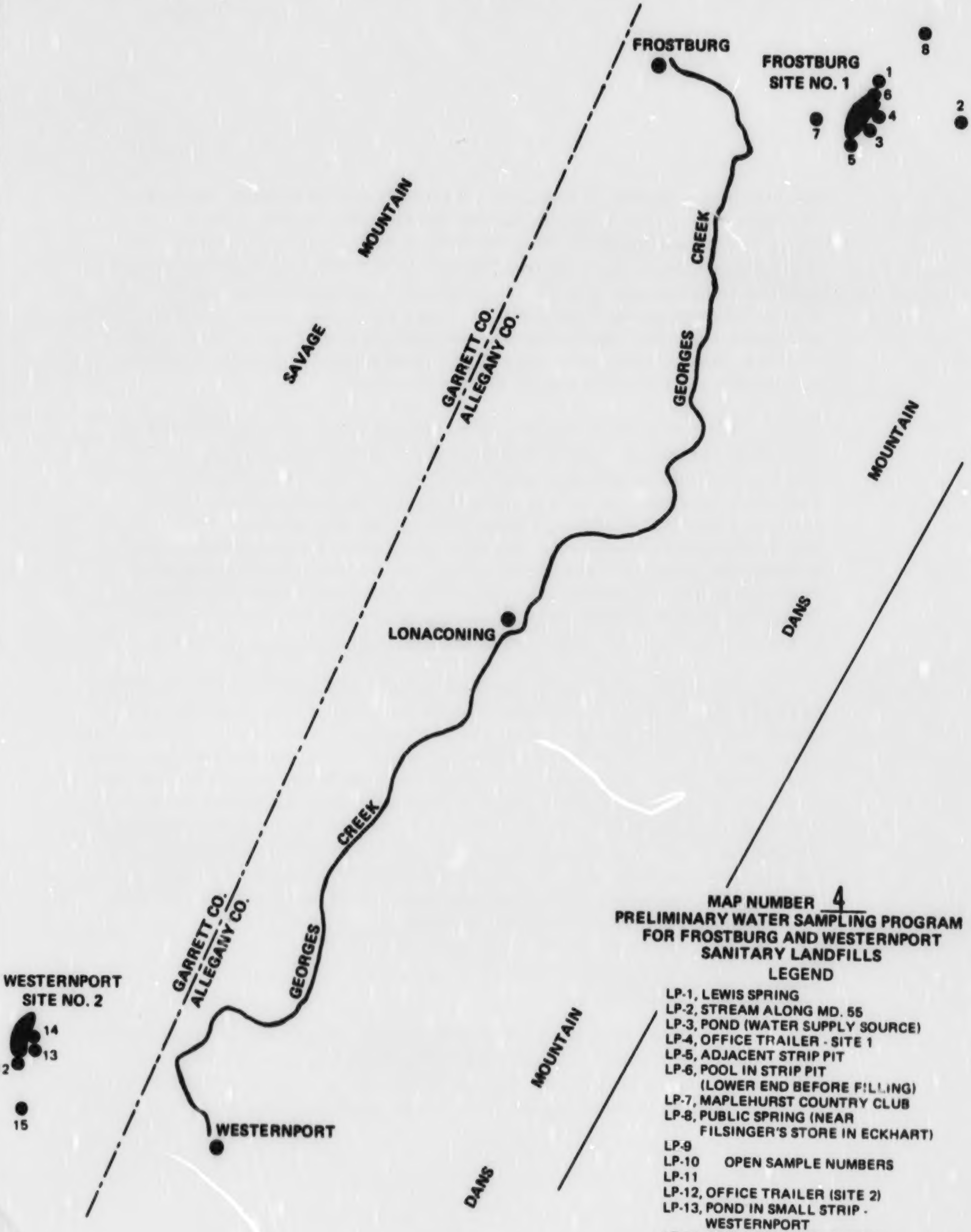
Although the sanitary landfilling of solid waste in abandoned strip mines appeared to have many advantages, it was necessary to prove the concept. Most strip mines offer a ready-made pit that is 30 to 150 feet wide and 50 to 75 feet deep, and often over a mile in length. An abundant supply of cover material is adjacent to the trench. Frequently, drainage and flood protection were provided during the strip mining operation.

Both sites used in this project had well constructed on site roads remaining from the mining operation. County maintained hard surfaced roads extended from the entrance of each site. Further, both sites were located within the refuse generation areas they served.

PRELIMINARY PROCEDURES

The procedures developed for establishing a sanitary landfill in a strip mine at the Frostburg site were later repeated for Westernport Site Number 2 when it was being considered for possible regional use. As with any properly planned sanitary landfill, the geology was reviewed to determine the usability of the site and what, if any, special procedures would be required to protect both ground and surface waters. Both the Maryland Water Resources Administration and the Maryland Geological Survey provided consultation during this preliminary stage.

The fill capacity and acceptability of adjacent spoil earth as cover material were parts of the initial investigations at Frostburg. The total pit volume


FROSTBURG
FROSTBURG SITE NO. 1
1
2
3
4
5
6
7
8
SAVAGE MOUNTAIN
GARRETT CO.
ALLEGANY CO.
GEORGES CREEK
LONACONING
DANS MOUNTAIN
WESTERNPORT SITE NO. 2
12
13
14
15
WESTERNPORT

MAP NUMBER 4
PRELIMINARY WATER SAMPLING PROGRAM
FOR FROSTBURG AND WESTERNPORT
SANITARY LANDFILLS

LEGEND

LP-1, LEWIS SPRING
LP-2, STREAM ALONG MD. 55
LP-3, POND (WATER SUPPLY SOURCE)
LP-4, OFFICE TRAILER - SITE 1
LP-5, ADJACENT STRIP PIT
LP-6, POOL IN STRIP PIT
(LOWER END BEFORE FILLING)
LP-7, MAPLEHURST COUNTRY CLUB
LP-8, PUBLIC SPRING (NEAR
FILSINGER'S STORE IN ECKHART)
LP-9
LP-10 OPEN SAMPLE NUMBERS
LP-11
LP-12, OFFICE TRAILER (SITE 2)
LP-13, POND IN SMALL STRIP -
WESTERNPORT
LP-14, ACID MINE STREAM NEAR
SMALL PIT
LP-15, SPRING ON MORAN'S FARM

NOTE: LP – LANDFILL PROJECT

approximated a quarter of a million cubic yards and the adjacent spoil earth was acceptable and of sufficient quantity for the cover material needs. Additional cover was available from the sides of the original mine walls. The overburden removed from the coal deposits in the area is a somewhat friable material and breaks down under the weight of earth-moving equipment into a mixture of small grained sand, silt, and clay which then becomes suitable as a cover material. Spoil piles will not make suitable cover if they cannot be broken down as previously described. Each spoil pile must be evaluated geologically for its acceptance as a cover material.

The estimated total pit volume justified the cost of developing the site and providing physical facilities required for its operation. In addition to preliminary geology, procedures were established in the fourth and fifth years for installing special types of monitoring wells to avoid further possible ground water pollution by the sanitary landfill operation. Site access was determined to be adequate, and only minor on-site improvements were needed. The costs for road improvements and other facility developments were well within the limits of feasibility for both sites. In addition, the site arrangement indicated that the equipment and manpower required would not be greater than that normally used at any well-operated sanitary landfill.

One of the most important features of the project was the development of a simple yet valuable data collection systems for use in providing background for future solid waste management planning. In addition to data of weight, time, and date, it was desirable to collect vehicle identification and type, nature of the waste, source of the waste, and weather conditions. To collect this data easily and accurately, several concepts were evaluated with the decision to code the information on special cards for later processing. The printer used was a designating key module with ten column capability, attached vertically beside the remote scale dial face. The basic information was planned for ultimate retrieval and incorporation with other information collected throughout the State in the future. (See Figure No. 1 for details)

PUBLIC ACCEPTANCE

Because of the history of bad practices and stigma attached to refuse disposal, a public information and education program was required to gain acceptance for the project. Public acceptance was of particular importance since the success of receiving the grant for the proposed Demonstration Project

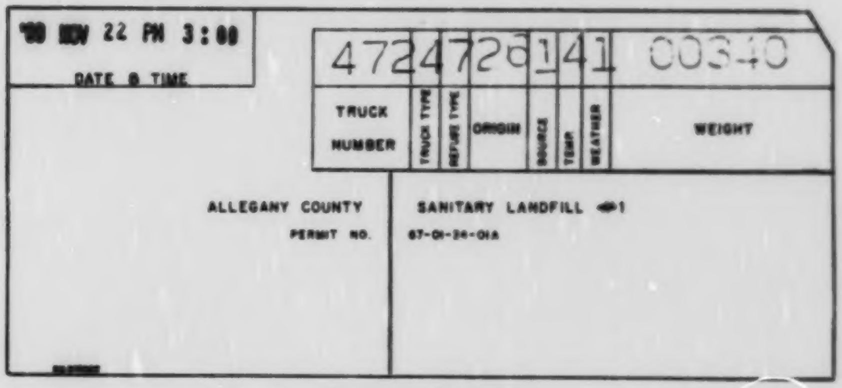
FIGURE NUMBER 1
DATA PRINTING KEYBOARD AND WEIGHT TICKET

TRUCK NUMBER			TRUCK TYPE	REFUSE TYPE	ORIGIN (ELECTION DIST.)		SOURCE	TEMPERATURE	WEATHER
9	9	9	9	Demolition 9	9	9	9	> 91 9	Snow Cover 1"-4" 9
8	8	8	8	Sewage Sludge& Treated Wastes 8	8	8	8	81-90 8	Snow Cover 4"-8" 8
7	7	7	7	Mixed 7	7	7	7	71-80 7	Snow Cover 8"-12" 7
6	6	6	6	Dead Animals 6	6	6	6	61-70 6	Snow Cover > 12" 6
5	5	5	Private Car 5	Street 5	5	5	5	51-60 5	Fog 5
4	4	4	Panel 4	Ashes 4	4	4	Agriculture 4	41-50 4	Snow 4
3	3	3	Stake Body 3	Non-combustible 3	3	3	Industrial 3	31-40 3	Shower 3
2	2	2	Dump 2	Combustible 2	2	2	Commercial 2	21-30 2	Rain 2
1	1	1	Compactor 1	Garbage 1	1	1	Residential 1	0-20 1	Clear 1
0	0	0	0	0	0	0	0	< 0 0	0

KEY BOARD

PERMIT NUMBER

67 – Year issued
01 – Site number
24 – Election District
01 – Disposal method
    A – Sanitary landfill
    B – Incinerator
    C – Composting
    D – Other



'80 NOV 22 PM 3:00
DATE & TIME

TRUCK NUMBER	TRUCK TYPE	REFUSE TYPE	ORIGIN	SOURCE	TEMP.	WEATHER	WEIGHT
472	4	7	26	1	4	1	00340

ALLEGANY COUNTY
PERMIT NO.

SANITARY LANDFILL #1
67-01-24-01A

WEIGHT TICKET

depended on written agreements with and partial funding by the participating local jurisdictions. Objections were raised during the initial period by service organizations, special interest groups, the news media, and individuals. Opponents were convinced that the proposed operation was "just another open dump." Many meetings were held with these objecting groups in order that representatives of the Division of Solid Waste Control and the Allegany County Health Department could explain the function and operation of the proposed sanitary landfill project. Finally, most opposing groups reluctantly agreed to accept the project. The Frostburg Council and allegany County Commissioners believed that the proposed project offered distinct benefits to the area and agreed to appropriate $13,200 as their share of the cost. In return, the State agreed to accept solid waste generated in Frostburg and the surrounding areas of Allegany County. The negotiations required several months before the public opposition subsided and the agreement was executed. Copies of the formal agreements between the local jurisdictions and the State Department of Health and Mental Hygiene appear in the Appendix. When the sanitary landfill operation began, representatives of local oppositon groups visited the site daily for the first two months and periodically for several months thereafter before they were convinced that the project was acceptable. Ultimately, the major opponents of Frostburg Site No. 1 became the project's most avid proponents and helped in gaining acceptance for Westernport Site No. 2.

As a final step toward public acceptance of the project and at the same time to eliminate any improper solid waste disposal method which affected the area, an inventory of all existing open dumps was conducted. As a result of this inventory, 87 open dumps were located within the county. Following the opening of the Demonstration Project site in 1967, the Allegany County Health Department began a campaign to remove all haphazardly located open dumps in the vicinity and a county financed crew of three laborers with one truck began transferring the accumulated roadside waste to the sanitary landfill. Clean earth was placed over the remaining debris and the sites were posted prohibiting all dumping. The local press, television and radio stations were enlisted in a campaign of public information in the cleanup effort. As a result, 35 of the 87 dumps have been eliminated and the effort is continuing.

PROJECT OBJECTIVES

As the project was being developed for a possible demonstration grant, certain basic project objectives began to materialize. It was obvious from the outset that such a project could make a major contribution to both solid waste management and strip-mine reclamation technology, if properly designed and operated. As the project progressed, additional objectives were added to gain maximum benefit from the operation.

The primary objective of the project was to develop operating procedures and equipment requirements for the filling of strip mines without causing further pollution either during or after the fill operation. If special pollution control procedures were required, this could be determined during the course of the demonstration project. It was also desirable to check the effect of the solid waste fill on acid drainage from strip mines to determine if any corrective benefits occurred during the filling and after the fill was completed.

A second major objective was to determine the minimum costs required to provide a sanitary landfill operation in an area where the population had become accustomed to the relatively low cost associated with the burning dump method for solid waste disposal. The cost determination was of particular importance since the anticipated small initial quantities of waste indicated a possible high operating cost.

It was also desirable to determine what amount of strip mine volume was available for refuse fill by establishing a ratio between refuse and cover material required to fill the pit and to regrade the unsightly adjacent overburden spoil piles. This objective was extended to include a regional inventory of abandoned strip mines and their associated volumes for possible future use in a statewide disposal plan.

As a result of the first year's operation, an additional advantage became apparent; namely, demonstrating the ability of a regulatory agency to operate an acceptable solid waste disposal facility, while complying with the same set of standards demanded of those facilities permitted and regulated throughout the State.

The location of the project on the fringes of Appalachia with its work force retraining program added the social objectives of determining the advisability of using persons in such a work experience program as part of the landfill operating force, thus removing them from the welfare program.

Upon initiation of the landfill operation, additional political subdivisions became interested in participating in the project. Consequently, the mechanics for developing the regional solution concept were available for the project even to the point of going beyond state borders.

In order that future facilities can be properly planned, a data collection system was developed for use at all central solid waste disposal facilities. By developing the system at the agency operated facility, continuous future modifications could be avoided when the system was initiated throughout the State.

The frequent delivery of small quantities of refuse to the site by homeowners not receiving regular collection service indicated the desirability of accepting these wastes after normal operating hours. It was, therefore, decided to provide the equipment and establish the controls necessary for round-the-clock receiving of refuse.

After two successful operating years with no adverse effects from the disposal operation, it was decided to add an objective which could benefit the environment rehabilitation of the entire area. Because of the economic impact of a long period of high unemployment, most heavy industries in the Cumberland area were following the area-wide practice of open burning their solid waste materials. During the third year, the decision was made to accept large quantities of industrial wastes to determine if these wastes could be disposed of without adversely affecting the efficiency of the landfill operation.

Operation of the project was extended a fourth and a fifth year to implement proposed research studies at Frostburg in the areas of groundwater movement, chemical and microbiological characteristics, land settlement, and vegetative cover. Additional funding was granted for the installation of industrial refuse contact beds at Westernport, although the operation of this sanitary landfill at this site was not funded for these two years. Details of these special studies are shown in the Appendix.

CHAPTER II

SITE SELECTION

Both Frostburg Site Number 1 and Westernport Site Number 2 were selected for their ability to satisfy the basic needs of the project and in serving the surrounding area. Site Number 1 is located approximately two miles from the Town of Frostburg, Maryland. Preliminary investigations, including the consideration of low population density and results of limited house to house attitude surveys, showed the greatest possibility of public acceptance for the Demonstration Project.

Frostburg Site Number 1 necessitated a short haul distance for the solid waste collected by the town yet required convenience for the residents of the surrounding area so that they could deliver their own refuse to the disposal facility. County-maintained paved roads provided direct access to the site and limited the cost for the development of additional access roads to those already existing on the site. The availability of acceptable access is a positive holdover from the strip mining operation.

Site Number 1 was selected to provide a minimum three-year fill life with flexibility for possible project expansion at the end of this period. The mine pit was approximately 1,900 feet long, 50 feet wide at the bottom, 110 feet wide at the top and varied in depth from 30 to 50 feet. The fill capacity was approximately 250,000 cubic yards. A smaller adjacent pit of approximately 3,000 cubic yards capacity was available for the initial operating period, while the larger pit was being prepared to receive solid waste. Since coal had been removed during early mining operations, the excavated earth overburden of shale and clay was stock-piled adjacent to the pit. This earth proved more than sufficient in quantity and volume for cover material for the landfill operation. The surface of the soil pile had been partially revegetated by the strip mine operator and care was taken to disturb as little of this area as possible.

Picture No. 2 Typical strip mine operation showing large capacity excavation and general landscape deterioration

Once an adequate volume of acceptable cover material was found to be available, the geology and hydrology of the proposed disposal site were investigated in cooperation with the State Water Resources Administration. It was found that the coal seam rested on solid rock which was relatively impervious as evidenced by the fact that water was present in the mine pit after the spring rains. It was determined that all the standing water in the pit has resulted from precipitation since springs were not encountered in the site area. Further investigation showed that siltation into the pit from excessive runoff could be avoided by construction and maintenance of simple diversion ditches. As a consequence of the site evaluation procedures, approval for the sanitary landfill operation was given by the Water Resources Administration and the State Bureau of Mines.

Picture No. 3 Typical abandoned strip mine showing excavation and cover material spoil banks

During the preliminary site investigation, availability of electricity, telephone service, water supply source, and access roads was found to be adequate.

Another major feature affecting the site development and its operation was the climatology of the area. The average annual temperature in Frostburg is approximately 51°F, ranging from about 31°F in January to about 71°F in July. Occasionally, temperatures in winter are as low as 22°F below zero. The average annual snowfall ranges from 30 to 60 inches and total annual rainfall is between 40 to 50 inches. Paper and debris transporting wind velocities of 15 to 18 miles per hour occur frequently for extended periods.

While the preliminary investigation indicated the technical feasibility of the Frostburg site, a public education program was required to gain acceptance of the project by local citizens. The effort was begun as soon as the technical feasibility was determined and continued throughout the project. A successful public education effort was required before legal approval could be obtained in the form of a written agreement between the local jurisdiction and the State. These efforts were time-consuming and since they delayed the beginning of the project, they must be considered an integral part of the preliminary site selection effort. The delay in opening the Frostburg site extended from the date of the grant approval notification, November 1, 1966, to April 1, 1967, when the first refuse was received for disposal.

WESTERNPORT SITE NO. 2

A second site was necessary to expand the project after the initial site became operative. In addition to the features investigated at the Frostburg site, further study was required before the second site was selected. While a primary function of the second site was to provide a partial solution to the regional solid waste problem, it carried the equally important requirement of having a substantial acid mine drainage problem associated with it. This second site also had to be small enough to be filled in about one and one-half years and to be within the problem area of refuse generation.

After a prolonged search, a suitable site was located within approximately three miles of the Town of Westernport. Attention is again invited to Maps Numbers 1, 2, and 3 which show, respectively, the general area of the State concerned with the Demonstration Project and specific locations of the Frostburg and Westernport sites. The mine pit at the site offered the combination of a small volume and a central location within the waste generation area. When first seen, it had an estimated acid water flow of 20 g.p.m.. Field tests of the water showed a pH of 3.2. The pit was approximately 200 feet long by 600 feet wide by 50 feet deep with a water depth of six feet resulting from precipitation, springs, and surface runoff. The access roads, cover material availability, geology, hydrology, climatology,

Picture No. 4 Typical abandoned strip mine with acid water pond and bare spoil banks

and pollution prevention considerations were similar to those previously considered technically acceptable at Frostburg Site Number 1 and the task of gaining public acceptance for this extension of the Demonstration Project was begun.

The central location of the Westernport site allowed waste to be hauled there from the towns of Westernport, Luke, and McCoole in Allegany County, Maryland; the town of Bloomington in Garrett County, Maryland; and the towns of Keyser and Piedmont in Mineral County, West Virginia, which complicated both the legal and public acceptance of the site. However, the successful operation at Frostburg eased the task of gaining public acceptance for Westernport, notwithstanding, the legal difficulties of the two-state problem more than made up for the easier public acceptance. Municipalities in West Virginia forbidden by law from entering into a financial agreement for more than one year without special legislation, and the Secretary of Health and Mental Hygiene of Maryland is prohibited from entering into financial agreements with other states. After seven months of negotiation between both states, the county health departments, and representatives of the local communities, it was realized that immediate action was required if the project expansion were to become a reality. As a result, the County Commissioners of Allegany County underwrote the state's share of the project cost and regained the additional cost from the West Virginia communities based on the degree of site use. Under these circumstances, Westernport Site Number 2 was approved and development work began. Copies of the various agreements appear in the Appendix.

CHAPTER III

LANDFILL DEVELOPMENT

Because of delays in gaining public and legal acceptance of the Frostburg Site Number 1, it was imperative to begin the waste disposal operation as soon as possible after these issues were settled. Therefore, the smaller abandoned mine pit previously mentioned was used. This allowed the fill operation to begin immediately and provided continuity of operation while the main pit was prepared and developed.

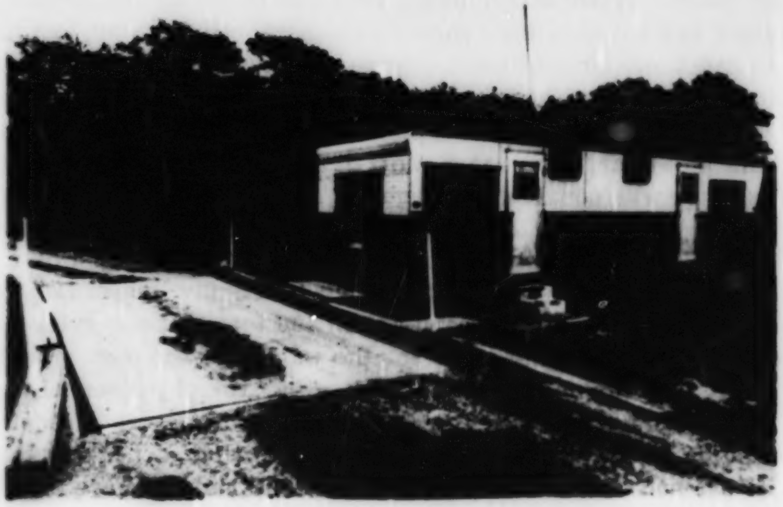
FROSTBURG SITE NUMBER I - PHYSICAL FEATURES

Modern sanitary landfill practice requires that certain basic physical facilities be provided for efficiency of operation and to maintain an aesthetically acceptable appearance. One of the first facilities constructed at the Frostburg site was a 24 foot by 24 foot structure to house the landfill equipment. The building was covered with corrugated aluminum siding and fitted with sliding doors. While this building provided the basic equipment shelter needs, a more refined structure should be considered for a project having a longer life expectancy or a larger equipment requirement. The building should be adequate to shelter the equipment and to allow performance of minor repairs out of the weather. Heating and lighting are desirable building additions to aid this function. However, for such a short-term demonstration project, the basic equipment shelter was considered adequate.

A septic tank-tile field sewerage system was installed by a local contractor under the supervision of the Allegany County Health Department. Water was obtained from a farm pond within 400 feet of the service area, and treated prior to use. The materials for the water system were purchased on a competitive bid, but the system was installed by project personnel under a permit from the Allegany County Health Department. The system required a 1/3 h.p. centrifugal pump, a pressure tank, a positive displacement hypochlorinator, a pressure filter, and the piping system. Coliform bacteria have not been found in water samples collected at the point of use.

An office facility is of equal importance with the equipment shelter for the efficient operation of a sanitary landfill. For a small operation, the office can be satisfactorily provided by using a mobile trailer which can also serve as a scale house. The trailer at the Demonstration Project served as a scale house, office, a toilet-locker facility, and lunchroom for the limited personnel at the sanitary landfill. The 10-foot wide by 36-foot long insulated trailer was equipped with hot and cold running water, toilet and shower facilities, electric heat and air conditioning, and a refrigerator.

A 10-foot wide by 25-foot long platform truck scale with a capacity of 40 tons was installed adjacent to the office trailer so the scale head and printer could be located in the trailer. The scale included a portable steel platform which could be moved to another site with a minimum of dis-



Picture No. 5 Scale house - office trailer with adjacent scale at the Frostburg Site Number 1 mantling and reassembling. A special printer recorded information on the data processing cards developed for use at the site. In addition to other information, the cards also included the owner's name and address and the area of collection. Vehicles which previously had not been weighed were weighed both before and after unloading. The tare weights thus obtained were then recorded on the weighmaster's list which was adjusted periodically to maintain its accuracy. Net weight and other information were coded and printed on the card while the vehicle was on the scale. The card was stamped by a separate time and dating machine as the truck moved off the scale. Cards were stored for key punching and for future data retrieval. Again, refer to Figure No. 1 for details. Graphs showing quantities and types of wastes are included in the Appendix.

A significant part of the unauthorized dumping in the county was attributed to householders not provided with refuse collection and disposal services. In order to help eliminate this practice, a container for receiving refuse was provided at the sanitary landfill for the convenience and safety of the householder. A structure was provided near the gate entrance for convenient unloading of refuse. This consisted of railroad tie retaining walls which formed a depression for parking a dump truck, equipped with extension sides. The lowered position of the truck allowed easy depositing of refuse in the container by anyone making use of the service. An automatically actuated light illuminated the area during hours of darkness in order to make it available to users on an around the clock basis. The truck was weighed prior to dumping to account for the total volume of privately delivered refuse entering the sanitary landfill.

Operating policies were followed as described in the Appendix. In the early period of the site operation, an automatic traffic counter was installed to determine the number of householder deliveries, but erroneous results attributed to malfunctioning during cold and wet weather conditions caused this practice to be discontinued.

FROSTBURG SITE NUMBER I - IMPROVEMENTS

While operating in the small pit during the initial three week period in April 1967, site improvements were being made in the main mine pit so that full-scale operation could commence as soon as possible. A 300 foot long ditch was excavated by blasting through from one to ten feet of solid rock in order to drain ponded water from an approximately 350 foot length of the pit. After the pit was dewatered, at the recommendation of the Water Resources Administration, a three foot layer of spoil material from both sides of the pit was compacted in the bottom of the entire cavity to cover the rock exposed during the blasting operations, and to prevent seepage.

A security gate and area lighting system were installed after the initial operating period to discourage vandalism. Finally, a sign setting forth hours of operation and rules for landfill users was erected near the entrance. Directional signs were placed along the road leading to the fill from the entrance to the working face. In a further effort to gain acceptability of the project, the area near the entrance was cleared of underbrush and vegetation, a white board fence was erected, and a lawn established.

Picture No. 6 Entrance treatment at Frostburg Site Number 1

FROSTBURG SITE NUMBER I - OPERATIONAL PROCEDURES

After the first five months, operating procedures for Frostburg Site Number 1 were routine. Refuse delivery vehicles were weighed on the truck scale before they deposited their loads at the operating face of the fill and then they left the site to continue on their collection routes. During the first five months of operation, before the scales were installed, waste quantities were estimated by using the dimensions of the delivery vehicles to determine their capacities. After installation of the scale, delivery vehicles were identified with their tare weights which were set on the fulcrum of the scale on future loads. (This information was recorded on special data processing cards by methods previously discussed).

After weighing, the delivery vehicle proceeded to the bottom of the operating fill face where its load was dumped and then left the area as expeditiously as possible by way of an exit road. The dumped solid waste was spread in one-to-two foot thick layers on a slope of approximately four to one and continually rolled by a crawler tractor to attain maximum possible compaction. As the fill in the strip mine was brought to finished grade, spoil from the surrounding area was hauled in self-propelled pans and placed for final cover over the fill area. Typical operation of a fill face and cross sections are shown in Figures 2 and 3. Bulky items were compressed by the tractor on firm ground before being incorporated in the fill. Automobile tires were placed on the bottom of the fill, where possible, to prevent them from working to the surface. Initially, a small 80 h.p. crawler tractor with a loader bucket was used to keep the capital cost as low as possible with the full knowledge that heavier equipment or special tractors would give greater compaction. As the project progressed and the quantities of refuse increased, heavier equipment was purchased and supplemented with rental equipment during periods of shutdown for repair and maintenance.

At the end of the operating day, the gate to the sanitary landfill was closed and locked. The tractor operator then spread and compacted six inches of clean cover material from the sides of the strip mine over the compacted refuse for fire prevention, as well as fly, litter, and odor control. The tractors were then stored in the equipment shelter. On the following morning, the tractors were serviced prior to returning to the landfill area.

To record the pit elevations, a temporary bench mark was established. Fill and borrow areas were mapped and grade stakes were set for the initial lift of fill. The landfill was designed with lifts six feet deep with minimum top slopes of 1.5 percent. The small quantity (20 to 60 tons) of refuse received daily under the initial operation in 1967 required a reduction in lift depth to three feet for efficiency

FIGURE NUMBER 2
TYPICAL MINE PIT FILLING OPERATION

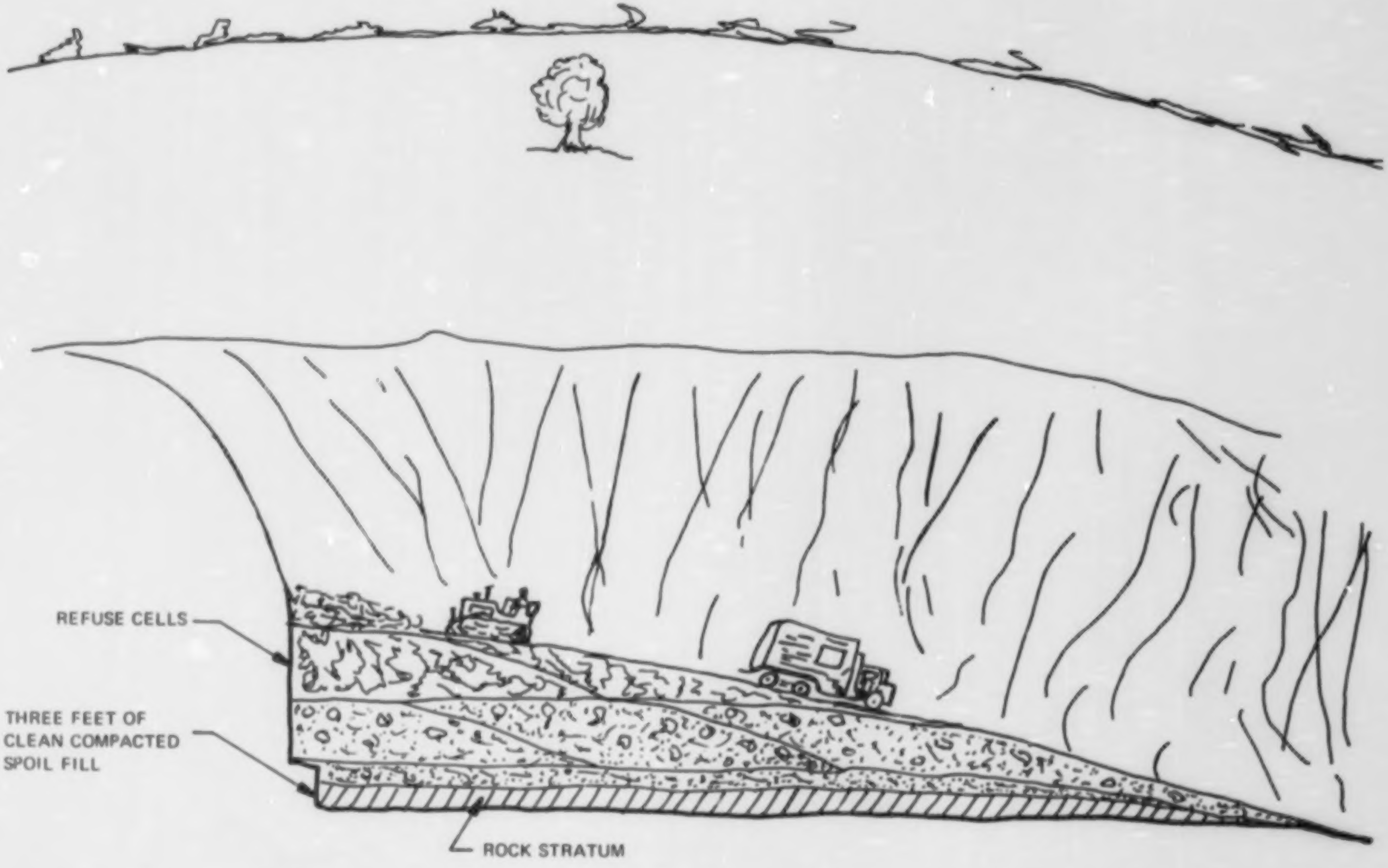
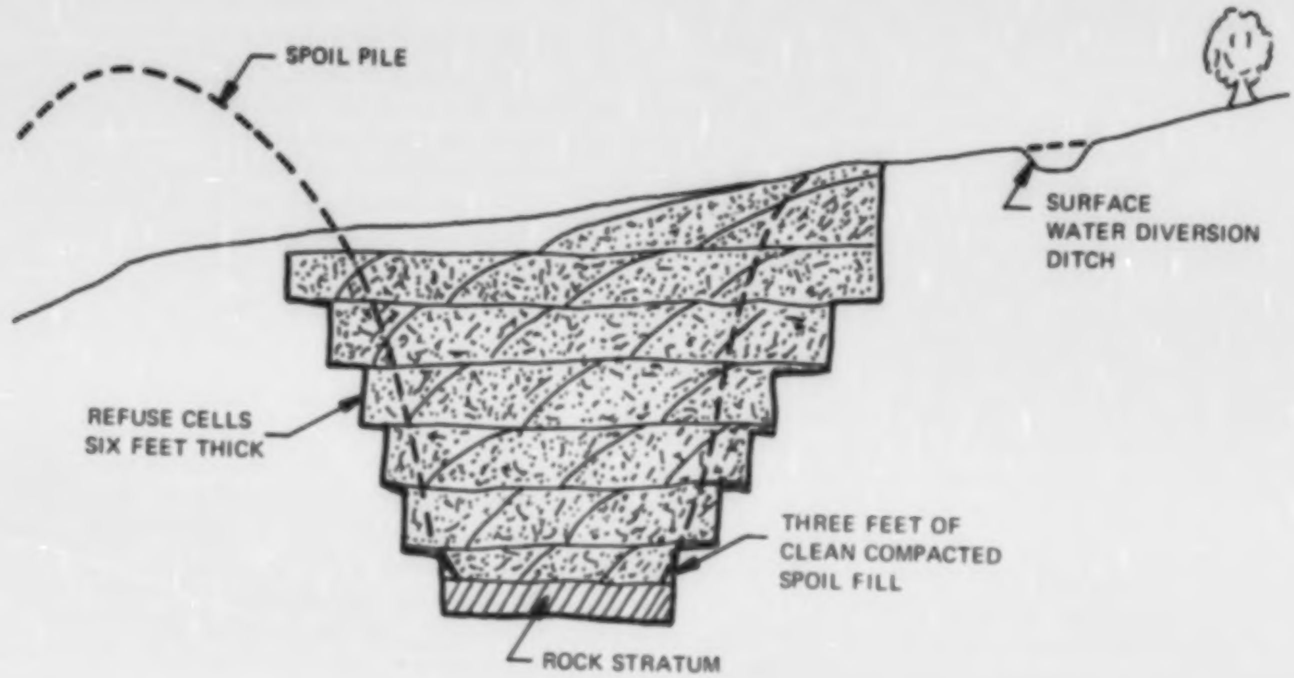
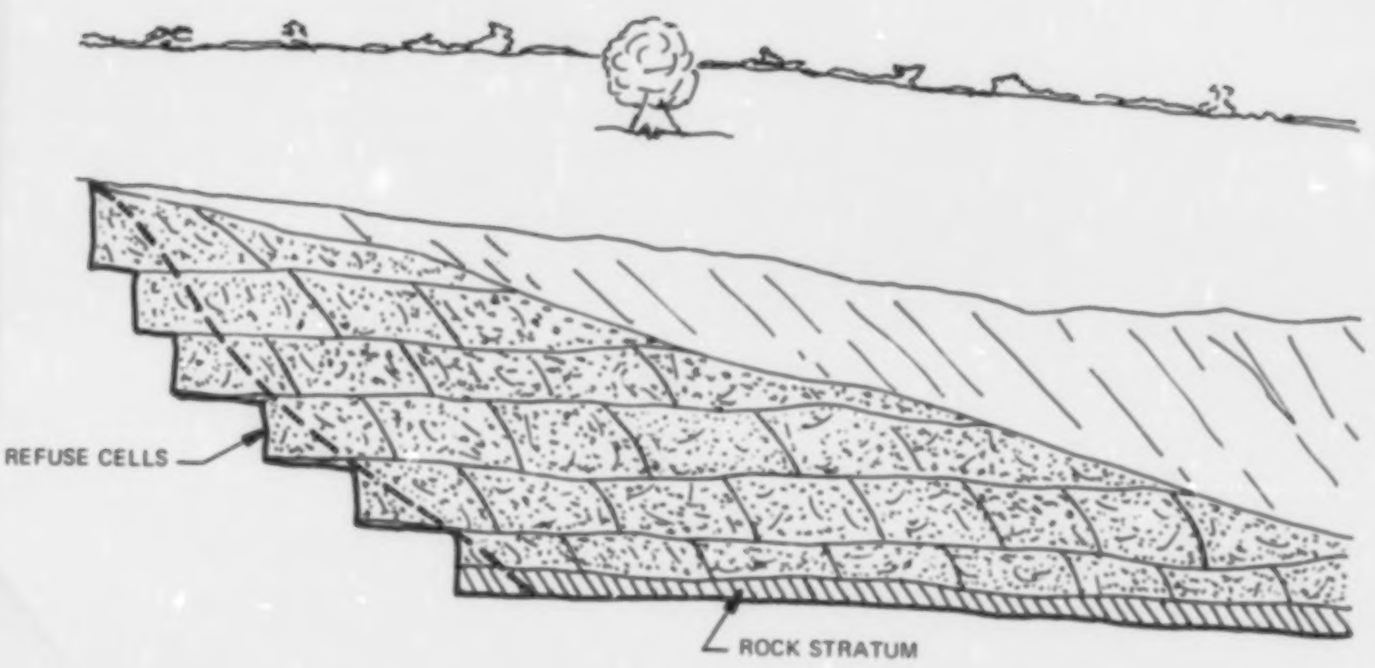

REFUSE CELLS
THREE FEET OF CLEAN COMPACTED SPOIL FILL
ROCK STRATUM

FIGURE NUMBER 3
CROSS SECTIONS OF MINE PIT FILLING OPERATION


SPOIL PILE
SURFACE WATER DIVERSION DITCH
REFUSE CELLS SIX FEET THICK
THREE FEET OF CLEAN COMPACTED SPOIL FILL
ROCK STRATUM


REFUSE CELLS
ROCK STRATUM

of operation. Additional solid waste generated by the 33,000 residents of the City of Cumberland in 1968, increased the daily quantity to a range of between 90 to 125 tons and allowed the original six foot deep design lift to be utilized.

On each day's operation, the refuse formed into a cell; and on succeeding day's operations, the cells were extended either laterally or longitudinally to provide continuity. When possible, vehicle traffic was directed over previously placed waste to gain additional compaction. The nature of the cover material allowed this practice, except in wet weather or periods of thawing when stockpiled road stabilizing material had to be used to maintain traffic movement. During freezing weather, care was taken to excavate loose cover material from the necessary depth in the storage pile to avoid the use of frozen cover earth which could not be spread evenly or compacted.

Succeeding lifts of fill were worked in the same fashion until approximately one-half of the length of the fill was brought to final grade. The final grade was planned to establish the initial grade or that which existed before the mining operation. The landfill was designed for all weather use. Upon reaching final grade in an area of the fill, it was seeded as described later in this report. Slopes were maintained at between 1.5 and 3 percent to provide reasonable runoff of surface water, yet minimizing erosion. A careful evaluation of cover material was made to develop slopes and surface water diversions to prevent erosion of the slopes and siltation damage to streams.

Picture No. 7 Service facilities at Westernport Site Number 2, showing scale house - office trailer, and equipment shelter

WESTERNPORT SITE NUMBER 2 - PHYSICAL FACILITIES

The same type of corrugated metal equipment shelter was provided at Westernport as was used at the Frostburg site. A septic tank - tile field system was constructed in accordance with the requirements of the Garrett County Health Department for individual sewage disposal systems.

Water was supplied from a rehabilitated spring on an adjoining farm. The spring was protected by a reinforced concrete box on which a masonry block building was constructed to house the pump and pressure tank. Water was delivered to points of use through a one and one-half inch plastic pipe approximately 500 feet long. Electricity and telephone services were provided from nearby overhead lines.

The office trailer provided at Westernport Site Number 2 served as the scale house, the landfill office, and the employees' sanitary facility-locker room. The 8 foot by 24 foot trailer was used to reduce the initial capital investment. As at the Frostburg site, the trailer was equipped with shower and toilet facilities, heat, lights, air conditioning, and a small refrigerator.

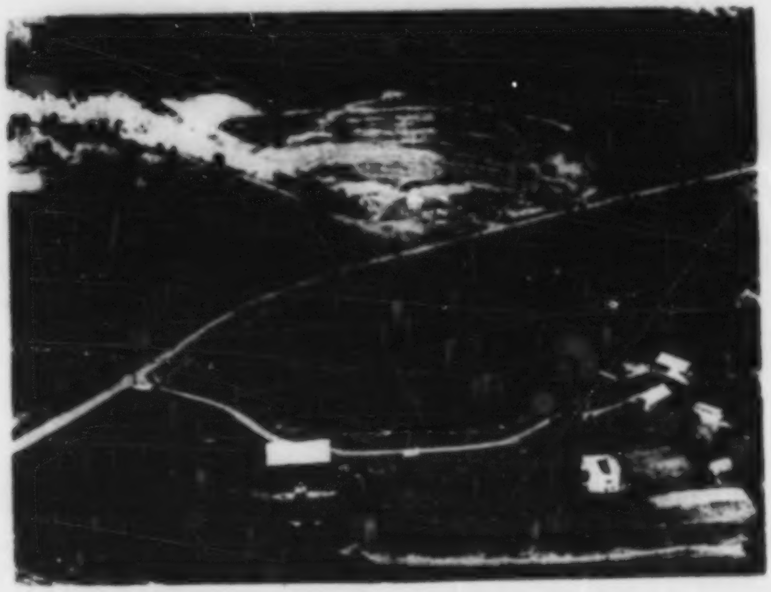
Because of specific problems at the Westernport site, a large bulldozer and backhoe were rented to clear brush and to excavate a 4 foot deep by 100 foot long ditch to drain ponded water from the pit. Again, as at Site Number 1, the Water Resources Administration required that the bottom of the pit be filled with clean earth from the spoil pile to control seepage.

While constructing off-site drainage diversion ditches, three springs were encountered along the eastern edge of the mine. They were diverted to a nearby stream by means of a six-inch pipe installed in a bed of crushed rock and covered with plastic film and two feet of clay for a seal. With the completion of this short-lived fill at Westernport Site 2 and its subsequent seeding, the drainage pipe was capped. As expected, properly maintained diversion ditches prevented excessive amounts of water from entering the fill. No evidence of leachate has been observed since December 1970.

WESTERNPORT SITE NUMBER 2 - OPERATING PROCEDURES

While the operating procedures at the Westernport site essentially duplicated those described previously for the Frostburg facility, some modifications were required to accommodate differing conditions of the site and acid mine drainage studies. The 80 h.p. tractor originally used at Frostburg was moved to Westernport and replaced by a heavier and more powerful tractor.

During periods when refuse delivery exceeded the capacity of the small tractor, additional equipment was rented to assist in the placing and compacting of the daily refuse and final cover as well as for carrying out road maintenance activities.



Picture No. 8 Completed Westernport Site Number 2. Center of photograph shows re-established contours and revegetation. Top of the photograph shows additional abandoned mines contrasting with the completed area

No special householder delivery facilities were provided for or needed at Westernport. Refuse receiving hours were set from 8:00 a.m. to 4:00 p.m., seven days a week to accommodate the communities and industries contributing waste to the operation. Special operating procedures for the acid mine drainage studies are described later under the discussion of environmental assessment.

Within approximately one year, the small pit at Westernport was filled and brought to the final grade. Heavy equipment was rented to spread and compact the final cover material over the pit area. This cover was then harrowed, limed, fertilized, and seeded.

GENERAL LANDFILL MANAGEMENT

A comprehensive set of sanitary landfill operational policies, procedures, and schedules is provided in the Appendix. These were applied at both project sites. At any sanitary landfill operation, blowing paper and wind scattered debris were problems requiring constant attention during periods when wind conditions were unfavorable. Under these conditions, only the constant policing of the area maintained its proper sanitary condition. To aid in solving this problem at both sites, all trucks were required to be covered, the loads were placed as directed by the landfill operator, the trucks were moved out from the fill area immediately, the waste was incorporated in the fill as soon as possible, and thin layers of cover earth were placed over the waste to hold it in place. Policing of the area was performed by landfill personnel and supplemented by laborers from the Allegany County Detention Center.

The control of disease-carrying vectors has been adequately accomplished at both sites by applying standard sanitary landfill practices in placing, compacting, and covering the refuse on a daily basis. When there was evidence of an occasional rat at the householder waste receiving bulk container at Frostburg Site Number 1, trapping was immediately initiated. No problems with birds, flies, or stray dogs were experienced at either site.

No long term problems were experienced with refuse fires. However, one accident resulting in a minor personal injury occurred when one of the bulldozers caught fire. The operator suffered only minor burns. The cause of the accident, according to the State Fire Marshal, was due to a cracked hydraulic line which sprayed hot fluids on an electrical connection of the machine. The bulldozer was almost a total loss.

Another problem concerning health protection was the disposal of 50 gallon card-board drums of carbon black from the Kelly-Springfield Tire Company. When containers of the material were punctured by the dozer, extremely fine, wind-borne particles tended to clog the nose and ears of the operator. The problem was solved by scheduling the delivery of the carbon black early each morning, digging a small depression at the toe of each day's cell, depositing the drums manually in these cells and then covering them with a 6 inch layer of earth. Additional loads of refuse were placed over the drums before the dozer began compaction.

CHAPTER IV

EQUIPMENT AND MANPOWER

Sanitary landfilling requires the most stringent duty classification of any mechanical equipment. The spreaders and compactors work constantly in a dirty environment and are continually exposed to the abrasive heterogenous constituents of the solid waste being filled. On small landfills this excessive duty is frequently compounded with the results of either minimal or no preventive maintenance and only token day-to-day care beyond the necessary fueling. All of these elements combine to reduce the equipment life expectancy and require that only the most rugged and best constructed machines be used at a sanitary landfill.

Other considerations for selecting basic sanitary landfilling equipment are availability and versatility. On a large sanitary landfill, special equipment can be purchased to perform intermittent tasks such as placing final cover, grading, and similar operations. The necessary back-up equipment for use during periods of maintenance and repair can be stored on the site for ready availability and for providing further flexibility of operation within a reasonable refuse disposal cost. Under these circumstances, special heavy steel-wheeled compactor tractors can be used to provide maximum fill compaction and volume reduction which ultimately will extend the life of the fill. The limited or non-existent ability of the compactor tractors to spread cover material requires that they be supplemented by other equipment for any small operation under 200 tons of refuse per day.

Even though a poorly compacted sanitary landfill is more acceptable from a health point of view than an open dump, it must be recognized that light weight equipment frequently produces little compaction, which increased the possibility of differential settlement and increased maintenance after the landfill is completed.

Regardless of the size of the equipment used, an all weather operation and constant duty require that operator comfort be considered. In mild climates, some landfill operators realize a minor equipment savings by providing only open tractors. This initial saving is quickly offset by low operator production during periods of inclement weather. In an area with climatic conditions similar to those encountered at this demonstration project as previously set forth in this report, no equipment should be considered without the minimum protection offered by a fully enclosed cab with heating capability. In most areas the small additional cost of a cab air-conditioner for summer use will be repaid many times by increased operator performance. However, in order to keep the initial capital cost low, the air conditioner is often left off the equipment purchased for small-scale operations.

Because of the equipment availability and flexibility required at a one-machine operation, the initial piece of equipment selected for the Demonstration Project had steel tracks in lieu of pneumatic tires or steel wheels. While the basic design of the machine spreads weight and reduces its unit-bearing pressure, and thus its compacting capability, this sacrifice was considered necessary to gain the required flexibility and dependability. Even when additional equipment was purchased, the one item of equipment operation required the application of this same selection philosophy.

FROSTBURG SITE NUMBER I - EQUIPMENT

At Frostburg, the project was initially planned to serve an estimated population of 15,000 to 20,000, with an expected waste generation of 20 to 60 tons per day. It was determined that an 80 to 90 h.p. tractor would be adequate for the task. Therefore, a 21,000 pound, 80 h.p. tractor loader with a one-and one-half cubic yard bucket was purchased for $19,000 on a competitive bid. The tractor had an all-weather cab and heater for operator protection and comfort. While the machine could theoretically spread and place peak rates of 100 to 150 tons per day on a short-term basis, the day-in-day-out operation indicated that its reasonable limit was less than 100 tons per day. The waste received at the site steadily increased to the point where in 1969-70, additional equipment was required. As a result of the experience gleaned from this project, the heaviest piece of equipment which can be financed by the operating revenue is recommended for use.

As the operation of the project progressed, the population served continued to increase and in 1968 with the addition of the 33,000 residents of the City of Cumberland, the population reached an estimated total of 50,000 people who were contributing approximately 90 to 125 tons per day by the end of 1968. Because of the previous experience with the small 80 h. p. machine and also the possibility that additional quantities of waste would be received, a larger tractor was desirable. The flexibility offered by the front-end loader was believed necessary and a new 185 h.p., 44,000 pound front-end loader with a three cubic yard bucket was purchased for $39,500 through competitive bidding. The tractor was equipped with steel tracks, an all-weather cab, and cab heater. The new tractor was placed at the Frostburg site and the smaller 80 h.p. machine was then moved to Westernport Site Number 2, where it was adequate for the smaller scale of that operation.

As the project continued into the fourth year (1969), increasing quantities of industrial waste were delivered to the Frostburg site and even more equipment was required. A continuing awareness of the benefits to be gained from using the heavier equipment and the increased quantity of solid waste required rental of a 195 h.p. tractor. Both a bulldozer with a specially designed blade for spreading refuse and a front-end loader equipped to excavate and haul cover material were considered. The bulldozer was selected because of its special ability to spread refuse. The approximately 54,000-pound tractor was equipped with steel tracks and a 5-foot high by 11.5-foot wide bulldozer blade.

Picture No. 9 185 h.p. front-end loader spreading and compacting daily cover at Frostburg Site Number 1

The value of this tractor was $52,200 complete with blade, all-weather cab, and heater. Both the new 195 h.p. and older 185 h.p. tractors were used concurrently.

Regular maintenance and repair or an accident such as the fire that removed the 185 h.p. unit from service for three months requires that back-up equipment must be available to perform the daily tasks. On a small sanitary landfill, these items of back-up equipment can be rented if they can be obtained within a period of two to four hours after they are needed. If this rental availability cannot be met by local contractors or equipment suppliers, the small sanitary landfill operator must provide his own back-up, just as the larger operator is required to do. In no instance can a loss of equipment availability be used to justify the use of other than standard sanitary landfill procedures at a disposal site. At Frostburg Site Number 1, a 115 h.p. tractor was rented to supplement and provide back-up for the purchased and rented equipment when required.

Other items of equipment were needed either on a continuous or part time basis. At Frostburg, a used five-ton dump truck was provided to receive householder delivered refuse, a surplus six-by-six tandem dump truck was used for dust control work, and a three-quarter ton pickup truck was available to haul personnel between the Frostburg and Westernport facilities. Additional equipment for the periodic tasks of maintaining and relocating drainage diversion ditches and access roads was either obtained from the county roads department or rented from construction contractors or equipment rental firms.

Although the tractors were purchased new, some of the auxiliary equipment was rented or purchased as used military surplus to keep the short-term costs to an absolute minimum. While this practice is justified for use in a demonstration project devised to show the acceptability of sanitary landfill operating procedures, it is economically unjustifiable on a facility designed to serve the long range needs of a community and is not to be considered as an expressed or implied recommendation from this report. A summary of equipment used at Frostburg Site Number 1, during each year, appears in the Appendix.

WESTERNPORT SITE NUMBER 2 - EQUIPMENT

Since the original Westernport disposal operation was considered a short term one-to-one and one-half year fill for the purpose of investigation of acid mine water correction capabilities of solid waste, the 80 h.p. tractor transferred from the Frostburg site was the only piece of equipment assigned there. As previously stated, the Westernport operation including site preparation, final covering, and grading was accomplished with rented equipment. Additional equipment, such as a water tank truck, back-up for the 80 h.p. tractor during periods of maintenance, and similar equipment items were either borrowed from the County or rented as required.

FROSTBURG SITE NUMBER I - MANPOWER

As with the previously described equipment, the manpower at the project site was minimal and increased only as the solid waste load made additional manpower necessary. The initial full-time operating personnel consisted of one weighmaster and one tractor operator in 1967. By 1970, personnel had increased to two tractor operators, a stand-by operator and a weighmaster. One heavy equipment operator shared the task of supervision at both sites. Additional labor was provided on a temporary basis to police the site.

A source of personnel for the sanitary landfill demonstration project was the local Work Experience Program. In the summer of 1967 representatives of the Allegany County Health Department and the Maryland State Department of Health and Mental Hygiene met with the leaders of the local Work Experience Program concerning the assignment of workers to the project. The program was at that time being administered by the County Department of Social Services. The object of the program was to get physically fit welfare recipients into a productive program where they would work for a living, develop employment incentive attitudes, become employable, and find regular employment.

Initially, one man was assigned to the Demonstration Project for a trial period. He had been receiving welfare payments for approximately six years. In a period of three months, this man proved quite reliable, worked effectively as a laborer and scale operator and was taught how to operate heavy equipment. He eventually mastered all of the equipment used at the sanitary landfill and was placed on the County payroll with the title of Landfill Equipment Operator.

This employee now has the total responsibility for operating a self-loading scraper pan at the new Allegany County refuse disposal site and has passed his civil service examination. It is believed that after more than five years of continuous and satisfactory employment, that it can be said that this person has fulfilled the objectives of the Work Experience Program.

As mentioned previously, the Allegany County Health Department with the joint cooperation and sponsorship of the Roads Department and Department of Social Services organized a roadside litter and dump clean-up program. Initially, three persons were assigned to assist a Roads Department truck driver in this effort. Later, others were assigned to the project to replace those removed for one reason or another. Two of the original Work Experience Program trainees in the clean-up campaign have been hired by the Roads Department and have been permanently employed for about four years. Another trainee is now gainfully employed in the food service industry.

Later, the Work Experience Program was transferred to the Department of Employment Security and called the Work Incentive Program. One trainee was assigned to the Westernport Site Number 2 in the fall of 1969. He has passed his civil service examination and has been in continuous employment for more than three years. All in all, it is believed that the Work Experience and Work Incentive Programs were quite successful and beneficial to the sanitary landfill Demonstration Project.

Going back to the main discussion, maintenance of all equipment is the responsibility of the landfill supervisor. Job Descriptions for permanent employees are shown in the Appendix.

WESTERNPORT SITE NUMBER 2 - MANPOWER

At the County operated Westernport site, the original equipment operator and weighmaster were supplemented by a standby equipment operator beginning in late 1969. As at the Frostburg site, supplementary labor was provided on a temporary basis as required. In addition, operators were provided with borrowed and short-term rental equipment. Job requirements for the permanent employee categories are shown in the Appendix.

CHAPTER V

ENVIRONMENTAL ASSESSMENT

The main concern of those associated with a combined project of sanitary landfilling and strip mine reclamation is to provide both a solid waste disposal system and to erase the evidence of past natural resource ravaging in a manner which offers a net benefit to society. Consequently, a project designed to demonstrate the acceptability of its operations must undergo a careful environmental impact evaluation before the associated operating procedures can be offered for general use.

HYDROGEOLOGICAL STUDY

One of the most important features in an environmental assessment is the hydrology of the site. The geology of Frostburg Site Number I is comparatively simple and uncomplicated by folds or faults. The coal was obtained from the Tyson seam of upper Pennsylvania age (approximately 270 million years old). The coal bed and overlying stratified sediments dip on a gradient of approximately four percent westward toward the structural basin or syncline essentially paralleling the Georges Creek basin. Consequently, any subsurface water or fluid would tend to flow from the mine pit toward Georges Creek.

Preliminary studies were conducted by representatives of the Maryland Water Resources Administration, the Maryland State Department of Health and Mental Hygiene, and the office of the Allegany County Engineer. It was recommended that the pit be drained of water and that the rock floor be covered with at least three feet of compacted earth from the spoil pile, before placement of any refuse, to cover any fissures thus preventing the migration of leachate or other contaminating materials into ground or surface water sources. This covering was installed during the site preparation phase.

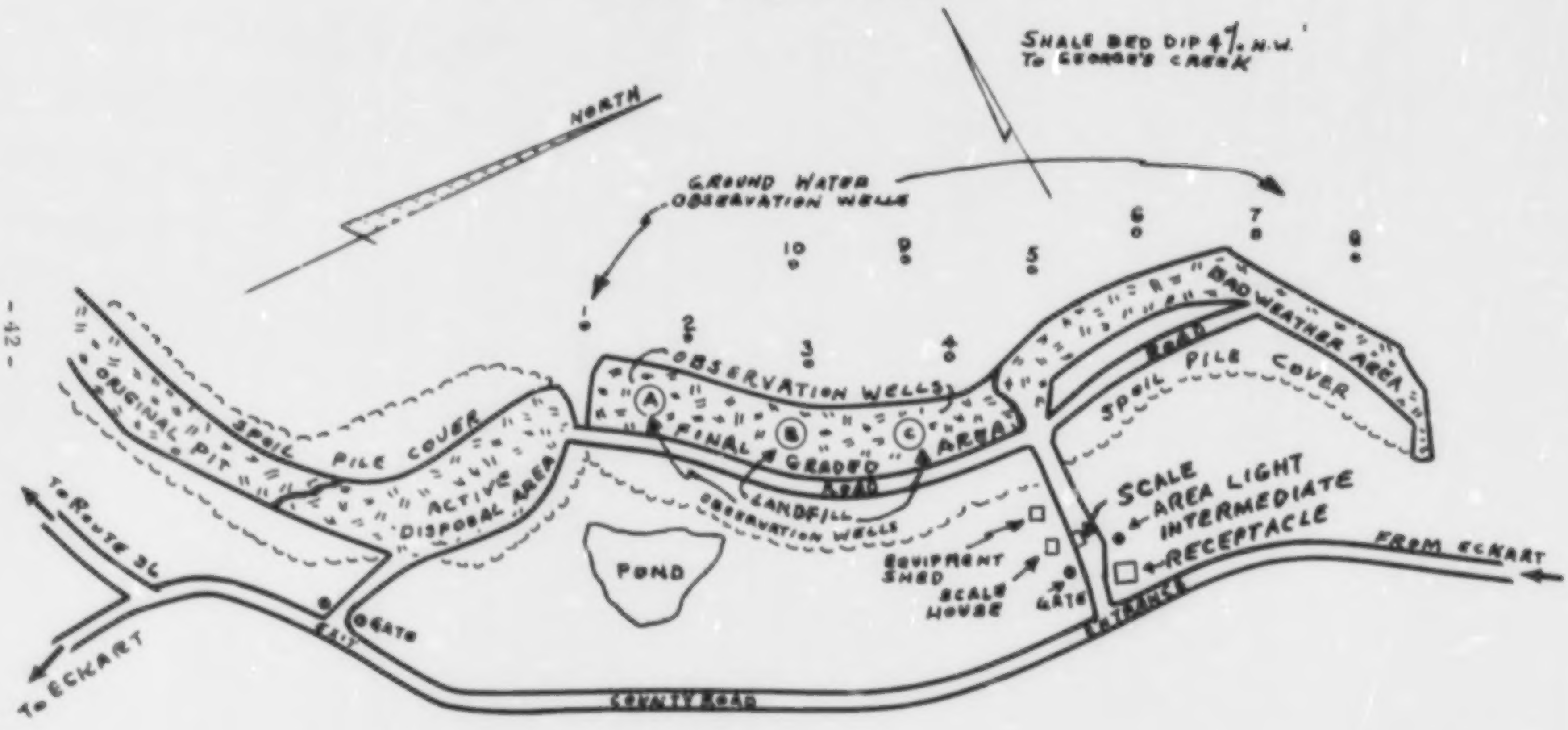
In January, 1970, test wells were installed at the Frostburg site in and adjacent to the fill area to detect any movement of leachate out of the mine pit. To date, no contaminants have been observed. (See Map Number 5 showing the locations of groundwater and landfill observation wells.)

The hydrogeological studies were performed by the staff of the Division of Solid Waste Control and a consulting geologist. Findings were transmitted by letter dated May 20, 1971, to the Chief of the Division in a

MAP NUMBER 5

FROSTBURG SITE NUMBER I

LOCATIONS OF GROUNDWATER AND LANDFILL OBSERVATION WELLS


SHALE BED DIP 4% N.W.
To GEORGE'S CREEK
NORTH
GROUND WATER
OBSERVATION WELLS
1
2
3
4
5
6
7
8
9
10
OBSERVATION WELLS
A
B
C
FINAL GRADED AREA
ROAD
LANDFILL
OBSERVATION WELLS
BAD WEATHER AREA
ROAD
SPOIL PILE COVER
ORIGINAL PIT
SPOIL PILE COVER
ACTIVE
DISPOSAL AREA
POND
SCALE
AREA LIGHT
INTERMEDIATE
RECEPTACLE
EQUIPMENT
SHED
SCALE
HOUSE
GATE
FROM ECKART
ENTRANCE
COUNTY ROAD
EXIT
GATE
To ROUTE 36
To ECKART

report entitled, "Geology and Hydrology of the Hoffman (Frostburg) Sanitary Landfill, Allegany County, Maryland." A copy of this report is included in the Appendix.

Picture No. 10 Monitoring well at perimeter of filled area at Frostburg Site Number 1

SPECIAL STUDIES

The project objectives of the fourth and fifth year grant extension, other than the hydrogeological evaluation, included studies on the chemical, microbiological, pesticide, herbicide, and settlement aspects concerned with the operation of the Frostburg sanitary landfill and observation of the vegetative growth resulting from the seeding of a completed portion of the landfill. At the same time, additional studies on the effects of industrial refuse on acid mine drainage were conducted at Westernport Site Number 2. The results of these studies are contained in the Appendix.

CHEMICAL STUDY

Chemical samples taken during the five year life of Frostburg Site Number I showed no evidence of the movement of contaminants from the landfill to the groundwater observation wells. Analysis of some samples pointed to the existence of several heavy metals in the groundwater. However, a literature search revealed a report entitled, "Rare Elements in Coal" by the Bureau of Mines, which contained information showing that coal deposits in the area of the Frostburg sanitary landfill do contain heavy metals in abundance. This fact, united with the aspects of an acid habitat and extremely large surface area of fractured coals, negates the notion of pollutional intramovement to groundwater. Further confirmation of this opinion is evidenced by the fact that boron was not found in the water samples tested, even though a boron compound was seeded in the landfill and utilized as a tracer element.

MICROBIOLOGICAL DATA

A variety of aerobic and anaerobic microorganisms, as well as some fungi were identified in samples collected on March 10, 1971. The types or organisms isolated exhibited no exotic species, but rather those which would normally be expected in soil-water habitats or in environments where refuse is mixed with soils.

PESTICIDE AND HERBICIDE DATA

Analysis of samples for pesticides and herbicides in the groundwater revealed the presence of some sulphur. It is doubtful that this finding can be attributed to the existence of pesticides since some suphur is normally present in the coals of the region. Standard chromatographic procedures revealed peaks which were analagous to peaks for DDT, DDD, and atrazine; however, none of the peaks were verified by thin-layer chromatographic techniques which are the confirmatory tests.

Chromatography analysis of the leachate samples from a landfill observation well was attempted, but was literally impossible to analyze due to the high content of greases and oils.

TEMPERATURE AND GASES DATA

Temperature records and ancillary data on the composition of gases from the landfill wells designated at A, B, and C (See Map No. 5) along with the data on the microbiological and settlement studies indicate that the landfill is still a viable fermentative habitat. How long the microbiological activity will continue to bring about chemical and settlement stability in this climatic region is purely speculative. While many environmental parameters interact to bring about ultimate landfill stability, the rates and mechanisms of these activities are not well understood. The testing devices installed at the Frostburg site will allow for the long-term collecting of much needed raw data.

SETTLEMENT DATA

In order for sanitary landfilling to be an acceptable method for permanently eliminating the scars of open-pit mining, it is necessary to develop a landfill procedure which will not only eliminate the pit, but will also assure that a large settlement rate will not create a new, although shallower, pit as the landfill waste decays.

At Frostburg Site Number I, monuments were constructed in conjunction with the landfill observation wells for continued monitoring of settlement, as shown in the Appendix. The design provided for free vertical movement between the monuments and well casings. Since the casings were driven to a stable geologic formation varying in depth from 50 feet to 85 feet below the surface, the elevation of a concrete monument will indicate the amount of settlement of materials within the landfill. Details on settlement are shown in the Appendix.

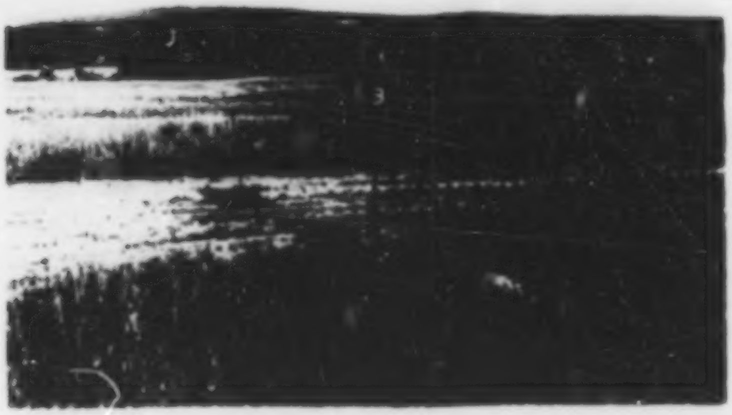
Picture No. 11 Test well and settlement monument on completed area at Frostburg Site Number I

VEGETATIVE COVER STUDY

In order to gain full benefit from the strip mine reclamation project, it was necessary to develop a final vegetative cover which would have self-perpetuating characteristics similar to those possessed by the natural hay and pasture grasses grown in the area. The plant species and seeding rates investigated were within the limits of normal agricultural practice. It was believed that this concept would offer the minimum cost to reestablish the vegetative cover using conventional farm equipment instead of higher cost methods such as hydroseeding.

The preliminary evaluation of this part of the project indicates the desirability of planting a grass-legume mixture on cover material which has been tested and properly prepared by cultivating, liming, and fertilizing to accept the seed.

No watering was performed on the test tracts in order to observe growth under natural moisture conditions. However, it is apparent that some supplementary watering will be required to establish vegetation on a completed sanitary landfill when extended periods of unusually dry weather exist. It is also apparent that continued monitoring will be required in order to evaluate properly the growth pattern of the different mixes under the varying conditions. It was further determined that normal farm-type equipment is suitable for use in the preparation and seeding operation. A full description of each test plot and data on seeding and fertilizer costs appear in the Appendix.



Picture No. 12 Completed fill area showing a revegetation test plot at Frostburg Site Number I

PRELIMINARY CONSIDERATIONS FROM FROSTBURG SITE NUMBER I

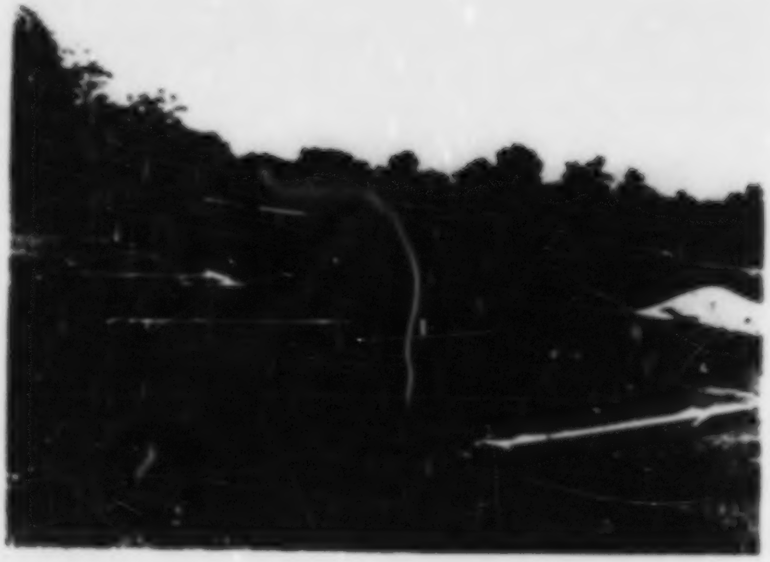
The site development for sanitary landfilling of strip mines requires that all off-site drainage of rainwater be diverted. The only water that then comes into contact with the acid salts of the spoil area and excavated pit is rain that falls directly upon the pit. The quantity of acid mine drainage from the site is, therefore, reduced. The proper placing and compaction of final cover material to a minimum slope of from 1.5 to 3 percent further diverts a substantial portion of any rainwater run-off from the completed fill.

The filling operation at the Frostburg site was started at the high point and worked toward the low point. This procedure progressively reduced accumulation of water at the low point, and accordingly, reduced the production of leachates. As the fill progressed, increasing quantities of uncontaminated surface run-off were diverted directly to surface water courses. Although a long period of monitoring will be required to develop the maximum correcting capability of a given fill material, the Frostburg operation provides sufficient justification for use of sanitary landfilling as a corrective procedure for acid mine drainage from abandoned strip-mine pits.

WESTERNPORT SITE NUMBER 2 - FILTER BED STUDIES

The acid mine drainage considerations at the Frostburg site allowed conjecture as to the short term pH correction capabilities of solid waste. They also indicated operating procedures which could ultimately solve the acid mine drainage problem from surface mines by diverting rainwater and filling the pits. While this concept is believed to be valid, the acid mine water investigation using filter bed systems was developed to determine the potential of the long range correction from solid waste fill.

The short term results of all the filter bed studies indicated a general enhancement of pH toward a less acidic condition. While this would be a desirable pH correction, the effluents from the beds all contained objectionable contaminants in the form of organic compounds, high color, suspended solids, and anaerobic odors. It is emphasized that these are short-term results which could be chemically treated on a large scale. The long-term analysis of the effluent from each bed, beyond an initial organic discharge may provide a reasonably low cost answer to the acid mine change problem. The results of the filter bed studies appear in the Appendix.



Picture No. 13 Test filter beds at Westernport Site Number 2 showing distribution trenches and sampling vent

CHAPTER VI

ECONOMIC ASSESSMENT

A primary advantage gained from filling abandoned strip mines with solid waste is that the required cost for disposal helps offset the required cost for restoration of the mined area. The strip mine can be located more remotely than is reasonable for a normal disposal site, yet it may be within an economically feasible distance because of the total costs and savings anticipated for combining the solid waste disposal and strip mine reclamation. This concept can be extended to compare this type of remote sanitary landfilling with the more costly process of volume reduction used in densely populated areas. It then becomes feasible to consider making long hauls to transfer waste from large metropolitan centers that originally used the coal occupying the pit.

The demonstration project has shown that abandoned coal strip mines can be restored by filling them with solid waste without harming the environment at a cost that does not exceed that incurred at a well-planned and properly operated sanitary landfill. The cost information developed can be used to evaluate operations having a similar capacity.

Detailed cost tabulations are contained in the Appendix. Since some supervisory and operating costs pertained only to the demonstration project and no interest had been included for capital improvements, a separate computation has been developed to reflect the equivalent cost to be expected by an operator contemplating the establishment of a disposal facility similar to the one at Frostburg. The 1969-1970 fiscal year was considered average for the demonstration project and is used in the equivalent cost computation. The following cost computation excludes all expenses for staff investigations, travel, tours and similar items because they were directly chargeable to the demonstration project but would not be encountered at a normal sanitary landfill.

Some tasks involved in the site improvement were performed by project personnel, and a minor adjustment must therefore be considered when comparing the tabulated costs. A further minor adjustment should be considered in the operating costs to account for equipment rented plus labor and fuel cost from the County Roads Department and labor provided at $3 per day from the County correctional system and for land costs.

EQUIVALENT 1969-1970 ANNUAL COSTS- FROSTBURG SITE NO. 1:

I: Capital Costs:

A: Site Improvements (life of fill 5 years)

1.	Site survey	$ 750
2.	Building and access roads	2300
3.	Trench bottom	500
4.	Diversion ditches	200
5.	Gates and fences	248
6.	Water supply system	698
7.	Electrical system	590
8.	Sewerage	355
9.	Equipment shed	2400
10.	Intermediate receptacle	165
11.	Trailer	3820
12.	Scales & auxiliary equipment	6608
		$18,634

6% for 5 years; factor = .2373964

18,634 x .2373964 = $4,423.64 $4,423.64

B: Tractors - 3 years

1.	1 - 185 h.p.	$39,500	
2.	1 - 195 h.p.	52,200	
		$91,700	
	91,700 x 6% @ 3 years = 91,700 x .37410981 =		$34,305.87

C: Miscellaneous Equipment - 5 years

1.	1 - Pickup truck	$ 2,931	
2.	1 - Dump truck	250	
3.	1 - Traffic counter	470	
		$ 3,651	
	6% for 5 years = .2373964 3.651 x .2373964		$ 866.73

D: Summary

A:	Site Improvements	$4,423.64	
B:	Tractors	34,305.87	
C:	Miscellaneous Equipment	866.73	
		$39,596.24	
	Total Annual Cost for Capital Outlay		$39,596.24

II: Direct Operating Costs:

A. Technical Services

1.	Consultants	$ 2,450	
2.	Field engineering	1,380	
		$ 3,840	$ 3,830.00

B: Equipment Repairs and Site Maintenance

1.	185 h.p. front end loader	$ 11,570	
2.	Emergency equipment rental	6,893	
3.	Trucks	200	
4.	Traffic counter	18	
5.	Scale (hammer repair)	206	
6.	Road repair	2,800	
		$ 21,687	$ 21,687.00

C: Supplies

1.	Equipment fuel	$ 3,500	
2.	Telephone	357	
3.	Electricity	700	
4.	Miscellaneous	957	
		$ 5,514	$ 5,514.00

D: Landfill Completion

1.	Seed, fertilizer, equipment, and labor	960	$ 960.00

E. Labor

1.	Landfill supervisor	$ 7,205
2.	3 Tractor operators (Includes relief operator)	16,428
3.	1 Weighmaster	5,476
4.	General supervision (Sanitarian II - 75%)	7,825
		$ 36,934

Direct Fringe Benefits at 8%	
Total Labor = 1.08 x 36,934 = 39,888.72	$ 39,888.72

F: Land Costs

1.	Ground rent	$ 1,050.00

G. Summary

A:	Technical services	$ 3,830.00
B:	Equipment repairs and site maintenance	21,687.00
C:	Supplies	5,514.00
D:	Landfill completion	960.00
E:	Labor	$ 39,888.72
F:	Land costs	1,050.00
		$ 72,929.72

III. TOTAL ANNUAL OPERATING COST

I:	Amortization and interest on capital expenditures =	$ 39,596.74
II:	Direct operating costs =	72,929.72
		$112,526.46

IV: UNIT COST

Total .1969 - 1970 refuse received = 77,714 tons
Total annual cost (with amortization and interest) = $112,526.46
Cost per ton = $112,526.46 ÷ 77,714 $1.45/ton

Some items which are acceptable at a demonstration project having a relatively short life cannot be considered adequate for a new landfill facility. The $250 surplus dump truck, for example, would need to be replaced by a new truck costing $13,000 to $15,000. A more substantial equipment service building, separate sanitary facilities for landfill operating personnel, and sanitary facilities for trash haulers would probably be needed. On the other hand, the amortization period would extend over a longer fill life than at the demonstration project, and this would offset some of these additional costs.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

This demonstration project was a pioneer effort in studying various effects of landfill and acid mine water by operating sanitary landfills at locations which previously had been abandoned strip mine pits. The operating period of the project has been adequate to allow certain conclusions to be drawn on its basic objectives. Further work at other locations by other investigators will be necessary before definite conclusions can be developed on some of the later objectives. Only those conclusions which have been substantiated are offered as valid.

CONCLUSIONS:

The most important determination from this demonstration project is that it is both economically and environmentally feasible to fill some of the abandoned strip coal mines in the western region of Maryland with solid wastes. Where initial evaluation indicates that a site is technically acceptable, the strip mined area provides an existing excavated pit for the sanitary fill with an immediately adjacent spoil stockpile for use as cover material. Access roads previously used for removing the mined coal provide ready access for heavy truck traffic associated with the delivery of solid wastes. It is also reasonable to expect future use of existing railroads as a proper extension of the present solid waste transportation system to serve the metropolitan areas that used the coal delivered by the same railroad system. The need to rehabilitate land laid waste by strip mining operations is added impetus to use refuse filling to offset the cost anticipated for regrading and revegetating these ravaged areas.

The operation of both Frostburg Site No. 1 and Westernport Site No. 2 proved that no special procedures or equipment are required beyond those normally expected at a conventional sanitary landfill. The close proximity of the stockpiled overburden allowed the covering operation to be accomplished by using a crawler loader to excavate, transport, spread, and compact the cover material over the filled solid waste. As with any sanitary landfill design, the total operation was developed to fit the requirements of the specific site to:

1. Be easily accessible in any kind of weather to all vehicles expected to use it.

2. Safeguard against water pollution originating from the disposed solid waste.

3. Safeguard against uncontrolled gas movement originating from the disposed solid waste.

4. Have an adequate quantity of earth cover material that is easily workable, compactable, free of large objects that would hinder compaction, and does not contain organic matter of sufficient quantity and distribution conducive to the harborage and breeding of vectors.

5. Conform with land use planning of the area.

The basic equipment evolved as the capacity of the operation increased from a few tons per day in the beginning of the project to 250-ton per day average. While a 185 h.p. crawler loader and a 195 h.p. crawler dozer provided an acceptable operation at the 250-ton per day average, supplementary equipment must be rented for backup when either piece of equipment is out of service. Any significant increase in the solid waste quantity would require an additional tractor.

The original operation began with the 4:1 volume ratio of refuse to cover, which is normal for sanitary landfills in this area of the country. The small initial settlement that occurred indicated that this was effective. Because of the final grading plan used, no maintenance will probably be needed for a long time. The 4:1 refuse-cover ratio was achieved by repeatedly constructing six-foot refuse fill lifts and covering them with six inches of spoil material daily. Final cover consisted of three to five feet of spoil material.

The original public objection to the use of the abandoned strip mine for sanitary landfilling was no different from that experienced on similar projects throughout the country. The erroneous idea that open dumping is practiced at a sanitary landfill must be overcome by proper public education before acceptance of any landfill project can be gained. The proper operating example seen at Frostburg Site No. 1 measurably reduced the time required to gain public acceptance of Westernport Site No. 2 and proved that the best public education effort consists of good operation of the disposal facility.

The round-the-clock receiving of private homeowner-delivered refuse to Frostburg Site No. 1 not only improved the total solid waste service available, but also allowed many citizens to view the site frequently. The good housekeeping practices carried out soon became widely known. As a result, sanitary landfilling is now publicly acceptable for strip mine reclamation in the service area.

Four tours were conducted in 1970 and 1971 to enable the people, interested government officials, and leaders of civic organizations of Maryland and other states to view the operation at first hand. The tours were designed so that future sanitary landfill proposals would be more amiably received by government officials and the general public by having witnessed the success of the Allegany County sanitary landfill. The tours: (1) successfully informed those attending, that practical solid waste disposal systems can be established through government and community initiative, assistance and effort; (2) provided visitors with the means to find out firsthand the information needed to establish effective solid waste management programs; (3) were an integral part and a necessary condition of receiving the demonstration grant.

POLLUTION EFFECTS:

The preliminary investigation procedure used when a strip mine is being considered for use as a sanitary landfill is essentially the same as that followed in the selection of any other proposed sanitary landfill site. A geological evaluation is necessary to avoid underground contamination if leachate forms. Offsite drainage diversion and other similar features must also be evaluated.

The acid mine drainage studies performed at Westernport lasted such a short time before grant termination that definitive conclusions cannot be drawn. The methods developed to test the effect of passing acid mine water through solid waste filter beds are believed to be reasonable for use by other investigators. Indications are that filters filled with normal household waste have a pH correction capability. Low pH values of approximately 3 were corrected to about 6 after passing the acid mine water through waste filters. No attempt was made to evaluate the economic feasibility of using large scale solid waste filters for pH correction because of the limited time available. However, it was noted that other contaminants were entrained by the water as it passed through the refuse filters, and additional investigation is required to determine if there was a net benefit from this type of acid water treatment.

The project did prove the basic premise that sanitary landfilling of abandoned strip mines will reduce the quantity of acid mine water correction.

ECONOMICS:

The Frostburg Site No. 1 operation increased in capacity from 20 tons per day initially to its terminal average of 235 tons per day on an annual basis. An annual cost of $1.46 per ton for the average rate of 235 tons per day was developed for the 1969-1970 fiscal year. This cost has been adjusted for more permanent facilities and other similar features which would be required at other than a demonstration project. This indicates that the cost for sanitary landfilling of abandoned strip mines can be expected to be the same or less than than expected for a similar capacity operation at other than strip mine locations. When the fill operation restores the area of abandoned strip mine to a semblance of its pre-mined condition and reduces the quantity of acid mine water pollution at no additional cost, it must be considered to be an economically sound operation. The proximity of adequate cover material simplifies operations and reduces transport equipment requirements to the absolute minimum.

It is reasonable to expand the operating costs developed during the demonstration project into the same general economic framework experienced with normal sanitary landfilling. On this basis, an economic evaluation can be developed for planners in which transfer methods and distances for landfilling of solid wastes will offer a cost advantage over volume reduction processes prior to final disposal. When strip mines are located within an economic haul-cost distance from any large solid waste-producing metropolitan center, they should be utilized as disposal sites.

FINAL LAND USE:

The revegetation studies and land settlement observations carried out on the completed portions of the Frostburg site show that the operating procedures used for sanitary landfilling of the strip mine resulted in the same kind of completed site as one produced by a conventional landfilling operation. Consequently, the same end uses ordinarily considered for completed conventional sanitary landfills can be contemplated for reclaimed strip mine areas.

ASSOCIATED BENEFITS:

The establishment of sanitary landfilling in strip mines in the demonstration project permitted both state and county health department personnel to gain valuable experience in the direct supervision of a sanitary landfill operation. The practical experience gained enables regulatory agencies to provide better guidance to communities in the state as they plan to convert from open dumping of refuse to sanitary landfilling. In addition, welfare recipients were furnished and trained for this work through the medium of a federally sponsored work experience program. Not only were these people removed from welfare rolls, but project supervisors were also provided with needed training capabilities.

FUTURE USE OF STRIP MINES:

An inventory of abandoned strip mines in the western coal mining regions of Maryland reveals that more than 2300 open pits exist and more are being created through continuing strip mining operations. A detailed investigation of only eighteen of the larger and most readily accessible pits indicated that they comprise a usable land area of approximately 1200 acres and have at least 20 to 25 million cubic yards of fill volume. It is apparent that sufficient fill volume exists to satisfy solid waste disposal requirements for many years.

As a result of the project's success, strip mine filling is now considered a proper method for solid waste disposal in the western part of Maryland. The long-range solid waste management plans for Allegany and Garrett Counties include utilization of abandoned strip mines as sanitary landfill sites, indefinitely.

RECOMMENDED FURTHER STUDY:

Sanitary landfilling of solid wastes in abandoned strip mines requires a long evaluation period before all of the potential ramifications can become apparent. The fact that the fill does not stabilize biologically in a short time means that the long-range effects must be studied. Even though sanitary landfilling in strip mines apparently does not differ from conventional sanitary landfilling methods, some procedures resulting from this demonstration project warrant further study. For example, the acid mine drainage studies conducted at Westernport must be considered primarily as having led the way to the establishment of testing methods. Further study should be performed to determine how long the pH corrective action of solid wastes can be expected. The persistency of this activity is dependent on varied aspects of the fill, ranging from composition of the filled waste to its liquid transmissability. It may be of benefit if this study is extended elsewhere by investigators who have more specialized research capabilities and can operate under more readily controlled environmental conditions. After more definitive data are collected, the economics of treating acidic water by using solid waste filters may be meaningfully evaluated.

The basic devices were installed at Frostburg Site No. 1 to allow hydrogeological monitoring to be continued after completion of the fill. For example, leachate and groundwater monitoring wells may be used to gather long-term data for use in studying:

1. Temperature fluctuations during year;

2. Long-term temperature drops in relation to time to determine active and residual decomposition of filled materials.

3. Rate of land settlement to determine the amount of earth cover and compaction needed to reduce maintenance problems resulting from decomposition of the filled materials.

4. The nature and quantities of gas emissions resulting from waste decomposition.

5. Various gases and states of decomposition, correlated with temperature and settlement data, for information which will shed light on:

    a. Active life of the decomposing fill materials
    b. Final settlement time
    c. Gas emission hazards
    d. Possible use of completed site for building construction
    e. Short and long-term leachate production factors

The revegetation studies conducted must be considered inconclusive without further monitoring of growth rate and survival of the various experimental vegetation tracts. Additional treatment of this undertaking should be provided as required and actions and results recorded in an effort to determine the long-range value of the various seed mixtures used. Even if nothing further is done to the tests tracts, a record should be maintained of individual tract histories.

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STRIP MINING LAWS
OF MARYLAND

AN ACT to repeal and re-enact with amendments, Sections 658, 661 (c), 664, 665 (b) and (f) and 666 of Article 66C of the Annotated Code of Maryland (1967 Replacement Volume and 1968 Supplement), title "Natural Resources," subtitle "Mining" subheading "Strip mining," and to repeal Sections 660, 667 and 674 of the same title, subtitle and subheading and to enact new Sections 660, 667 and 674 in lieu thereof, to stand in the place of the sections repealed; and to add new Section 662 (b-1) to this same title, subtitle and subheading, to follow immediately after Section 662 (b) thereof; to provide for a Land Reclamation Committee which shall review and approve reclamation plans, progress reports and final reports and which also shall set revegetation bonds and which may enter upon open-pit mining operations; and providing further that the Bureau of Mines shall have additional authority to suspend strip mining permits; and to provide also for aid to strip mine operators for reclamation costs; and relating generally to open-pit mining within this State.

SECTION 1. Be it enacted by the General Assembly of Maryland, That Sections 658, 661 (c), 664, 665 (b) and (f) and 666 of Article 66C of the Annotated Code of Maryland (1967 Replacement Volume and 1968 Supplement), title "Natural Resources," subtitle "Mining," subheading "Strip Mining," be and they are hereby repealed and re-enacted, with amendments; that Sections 660, 667 and 674 of the same title, subtitle and subheading be and they are hereby repealed and that new Sections 660, 667 and 674 be and they are enacted in lieu thereof, to stand in the place of the sections repealed; and that new Section 662 (b-1) be and it is hereby added to the same title, subtitle and subheading, to follow immediately after Section 662 (b) thereof, all to read as follows:

657. PURPOSE OF SUBHEADING

This subheading shall be deemed to be an exercise of the police powers of the State for the general welfare of the people of the State, by providing for the protection and conservation of the natural resources of the State and the improvement of areas of land affected in the mining of bituminous coal by the open pit, stripmining or auger mining method; to aid thereby in the protection of wildlife and to restore these lands to productive purposes; to decrease soil erosion, to aid in the prevention of the pollution of rivers and streams, to prevent combustion of unmined coal, to provide for reclamation of the stripped area, and generally to improve the use and enjoyment of these lands.

658. DEFINITIONS

The words and phrases defined in this Section have the meanings specified herein, unless a different meaning is plainly required by the context.

(a) "Open pit mining or strip mining" means the mining or recovery of bituminous coal by removing the strata or material which overlies or is above the coal deposit or seam in its natural condition. For purposes of this subheading auger mining shall be deemed an integral part of open-pit mining and subject to the provisions of this subheading.

(b) "Pit" means the place bituminous coal is being mined by the open-pit mining method.

(c) "Operation" means the pit or pits located upon a single tract of land or a continuous pit embracing or extending upon two or more contiguous tracts of land.

(d) "Land" means the surface of the land upon which open-pit mining is conducted.

(e) "Tract" means a single parcel of land or two or more contiguous parcels of land with common ownership.

(f) "Person" means any individual, firm, corporation, partnership, or other entity.

(g) "Operator" means a person engaged in open-pit mining, as a principal as distinguished from an agent or independent contractor.

(h) "Landowner" means the person in whom the legal title to the land is vested.

(i) "Overburden" means the strata or material overlying a bituminous coal deposit in its natural state and means such material before or after its removal by open-pit mining.

(j) "Spoil pile" means the overburden and reject coal as it is piled or deposited in open-pit mining.

(k) "Land affected" means the land from which the overburden is removed and that occupied by the spoil.

(l) "Abandoned" means an operation where no coal has been produced or overburden removed for a period of six months.

(m) "Degree" means the angle of slope from the horizontal

(n) "Auger mining" means the mechanical removal of coal from the subsurface by augering from the outcrop.

(o) "Deep mining" means all methods of extracting coal from the subsurface excepting open-pit mining and auger mining and includes such methods as drift mining, shaft mining, and inclined slope mining.

(p) "Director" means the Director of The BUREAU OF MINES.

(q) "Plan" or "reclamation plan" means the mining and Reclamation Plan.

(r) "Report" "progress report" or "reclamation report" means the annual mining and Reclamation Report.

(s) "Final report" or "final reclamation report" means the Mining and Reclamation Final Report.

659. REGULATORY POWERS

The Bureau of Mines may make rules and regulations necessary for preventing, minimizing, or repairing damage to the land or the natural resources associated with the land which may result from open pit mining operations. All rules and regulations adopted under the provisions of this subheading shall be enforced by the Bureau of Mines, and any operator found in violation of any such rule and regulation is subject to the penalties provided in this subheading. Nothing contained in this subheading shall be construed to abrogate or supplant any of the enforcement or regulatory powers of the State Department of Health and Mental Hygiene, the Department of Water Resources or the Water Resources Commission.

660. LAND RECLAMATION COMMITTEE

(a) There is hereby created a standing committee which shall be known as the Land Reclamation Committee, hereafter referred to as the "Committee," to be composed of nine members as follows: The Director of the Maryland Geological Survey, who shall act as Chairman. THE CHAIRMAN OF THE SOIL CONSERVATION DISTRICT SUPERVISORS OF ALLEGANY COUNTY, AND THE CHAIRMAN OF THE SOIL CONSERVATION DISTRICT SUPERVISORS OF GARRETT COUNTY or their designated representatives; two members representing the mining industry, APPOINTED BY THE GOVERNOR WITH THE ADVICE AND CONSENT OF THE SENATE FOR THREE (3) YEAR TERMS. THE DIRECTOR OR HIS REPRESENTATIVE of the following state agencies; The Department of Game and Inland Fish, The Department of Forests and Parks, The Department of Water Resources and the Bureau of Mines. The Committee members shall serve without compensation, other than reimbursement for travel and actual expenses incurred in the performance of their duties under this subheading. Funds for expenses will be provided for in the budget of the Maryland Geological Survey. The Committee shall meet at the Chairman's request, but in no case shall the meetings be held less ofter than twice a year. A quorum shall consist of five (5) or more members. A Majority vote of the full committee shall be necessary to approve any action.

(b) Duties: It is the duty of the Land Reclamation Committee to study, recommend and approve all procedures for reclamation, conservation and revegetation of areas affected by open-pit mining within the State of Maryland. Such measures shall include, but not be restricted to, backfilling and grading, the restoration of plant cover, the prevention of erosion, the prevention of the creation of acid water, and any other actions which will be conducive to the conservation and best utilization of the natural resources of Maryland. It shall be the duty of the Committee to review all mining and reclamation plans, progress reports and final reports. The Committee shall also set the amount of all revegetation bonds. The Committee may inspect or have inspected any open pit mining operation at any time in order to determine land reclamation, conservation and revegetation conditions. It is the duty of the Committee to establish plans and methods of procedure as well as practical guideline for the prompt and adequate reclamation, conservation and revegetation of all lands disturbed by open-pit mining of bituminous coal within the State of Maryland. These plans, methods of procedure, and practical guidelines shall be submitted to the proper regulatory agency. Finally the Committee is directed to review the strip mining laws of the State of Maryland to ensure compliance with the spirit of this act.

661. LICENSE REQUIRED

(a) It is unlawful for any person to proceed to mine coal by the open pit mining method as an operator within this State without first obtaining a license from the Bureau of Mines. Applications for licensure as open pit mining operators shall be made in writing to the Bureau, upon forms prepared and furnished by the Bureau. They shall contain such information as to the applicant or when the application is made by a corporation , partnership or association as to its officers, directors and principal owners, as the Bureau requires. The application for licensure shall be accompanied by a fee of one hundred dollars ($100.00). It is the duty of all persons licensed as open pit mining operators to renew the license annually, and to pay for each such license renewal the sum of ten dollars ($10.00). The application for renewal of a license as an open pit mining operator shall be made annually on or before January 1 of the next succeeding year.

(b) Penalty. Any person who mines coal by the open pit mining method as an operator without having applied for and received a license as herein provided is guilty of a misdemeanor, and upon conviction he shall be sentenced to pay a fine of not less than five thousand ($5,000.00) and not exceeding ten thousand dollars ($10,000.00), or to undergo imprisonment not exceeding six months, or both fine and imprisonment. The fine shall be payable to the Bituminous Coal Open Pit Mining Reclamation Fund.

(c) The Director shall investigate every application for a license or for a renewal, and HE shall not issue any new open-pit mining operator's license or renew any existing open-pit mining operator's license to any person or operator if HE finds that the applicant for licensure or renewal has failed to correct a violation of the rules and regulations established under this subheading or to comply with any of the provisions of this subheading. If the applicant is a corporation, partnership, or association, the Director shall not issue such license or renewal if HE finds that any officer or director or principal owner of such corporation, partnership or association, has previously failed and continues to fail to comply with any of the provisions of this subheading, or if any such officer or director or principal owner is or has been an officer or director or principal owner of any other corporation, partnership, or association, which has previously failed and continues to fail to comply with any of the provisions of this subheading. Nor shall the Director issue any license or renewal to any person or operator who has forfeited any bond posted pursuant to strip mining activities in any state of the United States of America. If the applicant is a corporation, partnership or association, the DIRECTOR shall not issue such license or renewal if HE finds that any officer or director or principal owner, of such corporation, partnership or association, has previously forfeited any bond posted pursuant to strip mining activities in any state of the United States of America.

662. PERMITS REQUIRED

(a) Before any person licensed as an open-pit mining operator proceeds to mine coal by the open-pit method, he shall apply to the Bureau of Mines on a form prepared and furnished by the Bureau for a permit for each separate operation, which permit when issued is valid until the operation is completed or abandoned, unless it is sooner suspended by the Director of the Bureau of Mines.

(b) As a part of each application for a permit, the operator shall furnish in duplicate, a U.S. Geological Survey quadrangle sheet, 7 1/2 Minute series (topographic) in a manner satisfactory to the Director of the Bureau of Mines showing the location of the tract or tracts of land to be affected by the operation contemplated. Aerial photographs shall be acceptable if the photographs show the details to the satisfaction to the Director of the Bureau of Mines. Such map, plan, or photograph shall be prepared and certified by a competent Engineer, Surveyor, or other person, approved by the Director, and shall show the boundaries of the area of land which will be affected, the drainage area above and below the area, the location and names of all streams, roads, railroads, and utility lines on or immediately adjacent to the area, and the nearest municipality. The map, plan or photograph also shall show the results of test borings which the operator may have conducted at the site of the proposed operation, and the plan shall include data such as the nature and depth of the overburden, the thickness of the coal seam, a complete analysis of the coal seam, the crop line of the coal seam, and the location of the test borings, the depth of the overburden, the thickness of the coal seam, the analysis of the coal sea, the crop line of the coal seam, and the location of the test borings holes shall be deemed confidential information and shall not be deemed a matter of public record.

(b-1) In addition to the information and maps otherwise required by this act, each application for a permit shall be accompanied by a detailed Mining and Reclamation Plan showing the manner, time and distance for backfilling, drainage, planting and general reclamation of the area affected. Such reclamation plans shall be reviewed and AND APPROVED by the Land Reclamation Committee. THE COMMITTEE SHALL HAVE A HEARING WITH THE OPERATOR WITHIN (15) FIFTEEN DAYS AFTER SUBMISSION OF THE PLAN. AFTER SAID HEARING THE PROPOSED PLANS SHALL BE APPROVED, REJECTED OR MODIFIED BY THE COMMITTEE. IF THE COMMITTEE TAKES NO ACTION UPON THE PLAN WITH (10) TEN DAYS AFTER THE HEARING THE PLAN SHALL BE CONSIDERED APPROVED. IF THE PLAN IS REJECTED OR MODIFIED BY THE COMMITTEE THE OPERATOR SHALL BE NOTIFIED IN WRITING OF THE REASONS FOR REJECTION AND/OR THE MODIFICATIONS SUGGESTED. THE OPERATOR MAY RESUBMIT THE PLAN WITH THE COMMITTEE'S REQUESTED CORRECTIONS AND/OR MODIFICATIONS TO THE DIRECTOR, IF THE CHANGES ARE CORRECTED THE DIRECTOR SHALL BE AUTHORIZED TO ISSUE THE PERMIT. IF THE COMMITTEE REJECTS THE PLAN THE DIRECTOR SHALL NOT APPROVE THE APPLICATION INVOLVED.

(c) Special Reclamation Fees. In addition to fees required in this SUBHEADING, every applicant for a permit to surface mine coal, before permit is issued, shall pay to the Director a special reclamation fee of thirty dollars ($30.00) for each acre of land affected (matched by the State), which fee is to be deposited in the Bituminous Coal Open Pit Mining Reclamation Fund. The payment shall be based on the same number of acres as that for which bond is required. The Governor each year shall place an item in the budget to provide for the matching moneys required by this paragraph. These matching funds may be provided by the State in the current budget at the time the permit is issued or in thenext succeeding State budget.

(d) The operator is responsible for the prevention of avoidable stream pollution in excess of standards established by the Department of Water Resources.

(e) Unless leases in existence on June 1, 1967, do not so provide or permit, the application for a permit shall include, upon a form prepared and furnished by the Bureau, the written consent of the landowner for entry upon any land to be affected by the operation, by the operator or by the State or any of its authorized agents, within a period of five years after the operation is completed or abandoned, for the purpose of backfilling planting, reclamation, and inspection.

(f) The Bureau of Mines shall not issue any additional permits to any operator who has failed, or continues to fail, to comply with the provisions of this subheading under any permit previously issued.

(g) If the requirements of this subheading are met and no claims are outstanding under this subheading against the operator, or in the case of any corporation against any officer or director, a permit shall be issued. Additional permits are subject to all requirements of the original permit.

(h) If the Director does not approve the application for a permit, or any amended application for a permit, he shall promptly notify the operator by registered mail setting forth his reasons therefor. The operator may then take such steps as are required to remove the objections.

663. BOND REQUIRED FOR EACH OPERATION

(a) After receiving notification from the Director that an application for a permit has been approved, but prior to commencing open pit mining, the operator shall file with the Bureau a bond for each operation, on a form to be prescribed and furnished by the Bureau, payable to the State of Maryland and conditioned that the operator will faithfully perform all of the requirements of this subheading. The bond shall be for two hundred dollars ($200.00) per acre based upon the number of acres of land affected, provided that no bond may be filed for less than sixteen hundred dollars ($1,600). Liability under the bond shall be for the duration of open pit mining at each operation, and for a period of five years thereafter, unless released prior thereto or held on that portion reserved for haulageways, deep mining, and auger mining locations as hereinafter provided. The bond shall be executed by the operator and a corporate surety licensed to do business in the State of Maryland. The operator may elect to deposit cash or negotiable bonds of the United States Government with the Bureau in lieu of a corporate surety. The cash deposit or market value of such securities shall be equal at least to the required sum of the bond. The Director, upon receipt of any such deposit of cash or securities shall immediately place it with the State Treasurer, whose duty it is to receive and hold the bond in the name of the State, in trust, for the purposes for which the deposit is made. The State Treasurer at all times is responsible for the custody and safekeeping of such deposits. The operator making the deposit FROM TIME TO TIME MAY demand and receive from the State Treasurer of the whole or any portion of any securities so deposited, upon depositing with THE STATE TREASURER, in lieu thereof, other negotiable securities of the classes herein specified having a market value at least equal to the sum of the bond.

(b) Amended Permit. The operator prior to commencing operations on any additional land exceeding the acreage covered by the original bond made in the application for a permit, shall post an additional bond. Upon receipt of the additional bond and such additional material as would have been required for the additional land has it been included in the original application to secure the permit, the Director of the Bureau of Mines shall promptly issue an amended permit covering the additional acreage covered by the additional bond.

(c) No operator may strip any area in this State by open pit mining who has previously forfeited any bond posted pursuant to stripping activities or who has failed to pay royalties and wages due during such activities.

664. REPORTS: MONTHLY, ANNUAL AND PROGRESS

(a) Monthly and Annual Reports: On or before the 25th day of each month, every operator of a coal stripping operation shall furnish the Bureau of Mines, on a form provided by the Bureau, a monthly report of coal produced, number of employees and days worked, and a report of all fatal and nonfatal accidents for the previous month. An annual report shall be furnished to the Bureau not later than the twenty-fifth day of February each year for the preceding year covering facts regarding the production and condition of the operation during the calendar year preceding as the Bureau may require.

(b) Mining and Reclamation Progress Report: If an operator continues to operate beyond one year, the Director shall be furnished with a new map at the end of each year of operation, on which is outlined the area affected and progress of reclamation during the preceding year. This Mining and Reclamation Progress Report shall contain information identical to that required for both the reclamation plan and the final reclamation report and shall show in detail completed reclamation work. Failure to the Committee to act upon a reclamation progress report within sixty (60) days after its submission shall constitute approval of the report. If no land has been disturbed by operations during the preceding year, the operator shall notify the Director of this fact.

(c) Inspections; effect of Non-Compliance: The Director or his agent may enter upon and inspect any open-pit operations for the purpose of determining conditions of safety and for compliance with the provisions of this subheading and all rules and regulations promulgated pursuant thereto. If an operator fails to comply with the requirements of this subheading, or any rules or regulations promulgated pursuant thereto, the Director shall immediately notify the operator by registered mail or by personal delivery by his agent of such failure and require compliance within a specified time. Unless the operator complies with the subheading and such rules and regulations within the time specified, the Director may issue a cease and desist order requiring the operator immediately to cease open-pit mining ON THE OPERATION IN QUESTION within this State until it is determined by the Director that the operator is in full compliance. If the operator persists in noncompliance, the Director, after hearing and final determination may cancel the permit on this operation. The Director may also order the immediate stopping of any operation that is started by an unlicensed operator or without the operator thereof having first obtained a permit as required by this subheading. In addition the Land Reclamation Committee may enter upon any open-pit operation for the purpose of determining land reclamation conditions and progress. Any deficiencies noted shall be reported to the Director. The committee may order the Director to suspend the permit until corrective action is taken.

665. BACKFILLING OPERATION

(a) Each operator shall comply with the requirements of this section.

(b) He shall regrade in a manner to be established by rules and regulations of the Director and in accordance with the approved plan. Such regrading shall include, but not be limited to the following:

(1) If spoil banks have been created, grade the surface of the spoil banks so as to reduce the depressions between the peaks of the spoil to a surface which restores the terrain to as near normal as is satisfactory to the Director. The grading shall be done in such a way as will minimize erosion due to rainfall and will also eliminate steep grades between peaks and make the surface more suitable for tree cutting or logging operations or cattle grazing or other suitable uses. The grading shall be done in a manner which will minimize, as far as practicable, the presence of large rocks, or materials which would be toxic to plant life, on the surface of the graded area.

(2) If the overburden deposits are composed of materials which are suitable for the support of tree growth, or the growth of grasses or other reclamation vegetation, or if such material can be expected to become suitable by natural leaching and weathering processes, the overburden material shall be graded so as to cover the final pit. The operator shall exercise measures required so as not to lose or make unavailable overburden material for the grading required by paragraphs (1) and (2).

(c) If the outside spoil depost is made on a steep hillside, rocks that have rolled down into a cleared valley shall be placed back at the toe of the hillside or deposited at some equally suitable location.

(d) He shall seal off with a fill all openings from underground mining operations at the base of the final cut. The sealing off with a fill shall be done in such a way as to avoid creating danger from the impoundment of large quantities of water.

(e) If the operator proposes to impound water to provide lakes or ponds for wildlife, recreational or water supply purposes, he shall file formal request with the Department of Water Resources and receive approval before the ponds or lakes may be created BY impounding water.

(f) Alternative Plans for Reclamation; Completion of Backfilling: An operator, with the written approval of the landowner, except where leases in existence on June 1, 1957, do not so provide or permit may propose alternative plans for reclamation wherein the land can be used for suitable purposes. The alternate plans shall be submitted to the Director as part of the Mining and Reclamation Plan. All backfilling shall be completed before backfilling equipment is moved from the operation.

666. COMPLETION OF FINAL REPORT

(a) Within thirty (30) days after the operation is finished or abandoned, the operator shall file with the Bureau of Mines, a completion report on a form to be prescribed and furnished by the Director, identifying the operation, stating the area of land affected by open-pit mining, and stating whether the operator intends to carry on deep mining upon the premises. The operator shall attach to the completion report a map of the operation certified by a surveyor, showing the boundary lines of the tract or tracts, the access to the operation from the nearest public highway, the area of land affected by open-pit mining and the locations reserved for deep mining. Also indicated upon, this map or submitted as a separate form shall be a Mining and Reclamation Final Report which shall contain information identical to that required for the initial reclamation plan and the annual Mining and Reclamation Progress Report. This report shall be reviewed by the Land Reclamation Committee and if the Committee does not approve the report, the Director, SHALL NOTIFY THE OPERATOR IN WRITING THE REASONS FOR REJECTING THE REPORT. THE OPERATOR MAY REQUEST A HEARING WITHIN TEN (10) DAYS AFTER NOTIFICATION OF THE REJECTION. THE COMMITTEE SHALL HOLD A HEARING WITHIN TWENTY (20) DAYS OF THE REQUEST FOR HEARING. IF AFTER THE HEARING THE COMMITTEE STILL DISAPPROVES THE REPORT THE DIRECTOR shall suspend the open-pit mining permit of the operator concerned until such time as the Land Reclamation Committee to act upon a report within sixty (60) days after its submission shall constitute approval of the report.

667. REVEGETATION BONDS

(a) The Land Reclamation Committee shall also establish revegetation bonds for each open-pit mining operation at the time of approval of the mining and reclamation plan. The amount of these bonds shall be based upon the estimated revegetation costs for the area affected by said operation. These bonds shall be cash, negotiable, surety or performance bonds and shall not be less than fifty dollars ($50.00) nor more than one hundred twentyfive dollars ($125.00) per acre. The bonds shall be deposited by the operator with the Bureau of Mines and upon receipt of any such deposit the Director shall immediately place it with the State Treasurer, whose duty it is to receive and hold the bond in the name of the State, in trust, for the purposes for which the deposit is made. When the Land Reclamation Committee approves the Mining and Reclamation Final Report INCLUDING THE PLANTING REPORT FILED BY THE STATE FORESTER UNDER THE PROVISIONS OF SECTION 668 OF THIS SUBHEADING, THE DIRECTOR SHALL RELEASE THE BONDS IN ACCORDANCE WITH THE PROVISIONS SET FORTH IN SECTIONS 668 AND 669 OF THIS SUBHEADING.

(b) To encourage optimum revegetation the Land Reclamation Committee may recommend to the State of Maryland that the State participate up to fifty percent (50%) in the cost of fertilizer, lime and seeds as may be required by an approved Mining and Reclamation Plan.

(c) The Director may receive funds from any source and, upon approval of the Land Reclamation Committee, spend said funds for reclamation and revegetation of strip mined areas.

668. PLANTING REPORT

Within one week after planting is completed the operator shall file a planting report with the Director of the Bureau of Mines, on a form to be prescribed and furnished by the Director giving the following information: (1) identification of the operation; (2) the type of planting; (3) the date of planting; (4) the area of land planted; and (5) such other relevant information as the Director may require. The Director of the Bureau of Mines shall submit this report to the State Forester, who shall inspect the premises, either in person or by his duly authorized representative, within one month after the planting report is filed. If the State Forester finds that the planting has been done in a workmanlike manner and that the area reported has been planted in accordance with the prescribed plan or procedure, or if the operator has been relieved from the obligation to plant trees, shrubs, or grasses as hereinabove provided, he shall so notify the Director of the Bureau of Mines, who shall release the bond and collateral in proportion to the area planted or relieved from planting. Upon such release the State Treasurer shall immediately return to the operator the amount of cash or securities specified thereon.

669. DISAPPROVAL OF PLANTING

If, upon inspection, the State Forester does not approve the planting he shall notify the Bureau and the operator in writing, setting forth the reasons therefor. The operator shall then take such steps as are required to remove the objections.

670. FORFEITURE OF BOND OR DEPOSIT

If the operator fails or refuses to comply with the requirements of the subheading in any respect for which liability has been charged on the bond, the Director shall declare this bond forfeited, and he shall certify the case to the Attorney General, who shall proceed to sue out and collect the amount of liability forfeited thereon; and if the operator has deposited cash or securities in lieu of bond the Director shall declare that portion of the deposit forfeited, and he shall direct the State Treasurer to pay the funds into the Bituminous Coal Open Pit Mining Reclamation Fund or to proceed to sell the securities to the extent forfeited and to pay the proceeds thereby into the Bituminous Coal Open Pit Mining Reclamation Fund.

671. PENALTY FOR FAILURE TO OBTAIN PERMIT

Any operator who mines coal by the open pit mining method without having received a permit, as herein provided, or who mines coal by the open pit mining method without securing an amended permit, or who mines coal by the open pit mining method without having furnished the proper bond, as herein provided, or who has knowingly or intentionally filed false information in the application for a permit, or who has not fully complied with all the provisions and requirements of this permit, is guilty of a misdemeanor, and upon conviction he is subject to a fine of not less than five hundred dollars ($500.00) or not exceeding five thousand dollars ($5,000.00). The fines shall be paid into and held by the State Treasurer in the Bituminous Coal Open Pit Mining Reclamation Fund, provided for in Section 673 of this subheading and shall be used by the Director of the Bureau of Mines for the sole purpose of foresting or reclaiming land affected by open pit mining of bituminous coal.

672. PROSPECTING FOR COAL

The provisions of this subheading do not apply to any person engaged in prospection for coal if no coal is marketed. Any person or operator failing to backfill prospected area within a reasonable time in accordance with the regulations of the Bureau of Mines upon conviction thereof shall be fined not less than two hundred dollars ($200.00) or more than five hundred dollars ($500.00).

673. DISPOSITION OF FUNDS

(a) All funds received by the Director from LICENSE fees and from the forfeiture of bonds and of cash deposits and securities shall be DEPOSITED TO THE CREDIT OF THE STATE TREASURER IN SUCH BANK OR BANKS AS HE MAY DESIGNATE, AND SHALL BE MAINTAINED AS A SPECIAL FUND ON THE BOOKS OF THE COMPTROLLER OF THE TREASURY IN AN ACCOUNT, to be known as the "Bituminous Coal Open Pit Mining Reclamation Fund," to be used by the Director of the Bureau of Mines for backfilling, grading, and planting the area of land affected by the operation upon which liability was charged on the bond. Any funds received from a forfeiture in excess of the amount which is required for backfilling, grading, and planting, the area of land affected by the operation upon which liability was charged, and funds received from forfeitures relating to land where backfilling, grading and planting is determined by the Director of the Bureau of Mines to be physically impossible, and funds received from special reclamation fees established by Section 662 (c), or from any other source, may be used by him for the foresting or reclaiming of other lands affected by open pit mining of bituminous coal.

(b) If one operator succeeds another at any uncompleted operation, either by sale, assignment, lease, or otherwise, the Director of the Bureau of Mines may release the first operator from all liability under this subheading as to that particular operation; if both operators have registered and have otherwise compiled with the requirements of this subheading and the successor operator assumes as part of his obligation under this subheading all liability for backfilling, grading, planting, and reclamation on the land affected by the former operator.

674. PITS MINED PRIOR TO JUNE 1, 1967. PITS MINED FROM JUNE 1, 1967, to JULY 1, 1969

All pits mined prior to June 1, 1967, under then valid permits, and for which legally sufficient backfilling bonds had then been posted, shall be backfilled in accordance with the requirements of Sections 657 to 674, inclusive, of this Article, as said sections existed immediately prior to June 1, 1967. All pits mined between June 1, 1967, and July 1, 1969, under then valid permits, and for which legally sufficient backfilling bonds had then been posted, shall be backfilled in accordance with the requirements of Sections 657 to 674, inclusive, of this Article as said sections existed immediately prior to July 1, 1969.

SEC. 2. Permit holders as of July 1, 1969, And be it further enacted, That operators holding strip mining permits as of the effective date of this Act shall submit a Mining and Reclamation Plan to the Bureau of Mines within twelve (12) months of the effective date of this Act pertaining to that portion of the operation not yet affected. THE LAND RECLAMATION COMMITTEE SHALL REVIEW THE PLAN IN ACCORDANCE WITH THE PROVISIONS OF SECTION 662 (B-1) OF THIS SUBHEADING. After plans have been approved operators shall submit annual and final mining and reclamation reports to the Bureau of Mines in accordance with the provisions of this subtitle.

SEC. 3. And be it further enacted, That if any provisions of this Act or the application thereof to any person or circumstances is held invalid for any reason, such invalidity shall not affect the other provisions or any other application of this Act which can be given effect without the invalid provisions or application, and to this end, all the provisions of this Act are hereby declared to be severable.

SEC. 4. And be it further enacted, That this Act shall take effect July 1, 1969.

HOUSE BILL NO. 1094
ABANDONED MINE DRAINAGE CONTROL ACT OF 1970

AN ACT to add new Sections 675 through 682 to Article 66C of the Annotated Code of Maryland (1957 Edition, 1967 Replacement Volume, 1969 Supplement), title "Natural Resources," subtitle "Mining," to follow immediately after Section 674 thereof, and to be under the same title and subtitle, and to be under the new subheading "Abandoned Mine Drainage Control Act of 1970"; authorizing the Secretary of the Department of Natural Resources to prevent, control, and abate pollution from abandoned mines; to acquire land occupied or degraded by abandoned mines; and authorizing the creation of a State debt in the aggregate principal amount of five million dollars ($5,000,000), the proceeds of which shall be used to meet the capital costs of such a program, and providing generally for the issuance of State bonds evidencing such debt.

SECTION 1. Be it enacted by the General Assembly of Maryland, That new Sections 675 through 682 be and they are hereby added to Article 66C of the Annotated Code of Maryland (1957 Edition, 1967 Replacement Volume, 1969 Supplement), title "Natural Resources," subtitle "Mining," to follow immediately after Section 674 thereof and to be under the same title and subtitle, and to be under a new subheading "Abandoned Mine Drainage Control Act of 1970," all to read as follows:

675.

It is the intention of the General Assembly to provide for the restoration of State waters affected by pollution from abandoned mines to the quality necessary to support fish and other aquatic life, recreation, and other beneficial purposes. To accomplish this objective, the Secretary of the Department of Natural Resources is hereby expressly authorized to acquire and rehabilitate land occupied or degraded by abandoned deep and strip mines so that such land does not contribute to water pollution, and to take whatever other measures are necessary to prevent, control, and abate water pollution from abandoned mining areas.

676.

As used in this subheading:

(a) "Costs" shall include the costs of acquisition, improvement, development, rehabilitation, construction, reconstruction and development of land and facilities and the financing thereof, including the cost of engineering and legal services, appraisals, plans, specifications, surveys, investigations, feasibility studies, estimates of costs and of revenues, and other necessary or incidental capital expenditures.

(b) "Studies" means the collection, analysis, and preparation of information, alternatives, and recommendations in order that the State or its political subdivisions may singly or jointly determine a course of action to meet the purposes of this subheading.

(c) "Land" means real property, including improvements, rights of way, water, riparian or other vested rights, easements, privileges, and any other estate or interest in real property.

(d) "Secretary" means the Secretary of the Department of Natural Resources.

(e) "Department" means the Department of Natural Resources.

677.

(a) The Board of Public Works is hereby authorized and directed to issue a State loan to be known as the "Mine Reclamation and Water Quality Restoration Loan of 1970," in the aggregate sum of five million dollars ($5,000,000). The certificates evidencing said loan may be issued all at one time or, in groups, from time to time, as hereinafter provided. All of said certificates evidencing said loan, or any group thereof, shall be issued according to a serial maturity plan to be established in the resolution authorizing the issuance of said loan or any portion thereof, which plan need not be in equal par amounts or in consecutive annual installments but shall be so worked out as to discharge the principal represented by said certificates within fifteen (15) years from the time of its issue; provided, however, that it shall not be necessary to provide for the redemption of any part of the principal represented by any certificates for the first two (2) years from the time of the issuance of said certificates.

(b) The Board of Public Works shall and is hereby authorized and empowered to, pass a resolution or resolutions, from time to time. determining and setting forth:

(1) The proportion of the total loan authorized by this Section which shall be issued at any particular time.

(2) The form of the certificate representing the loan or part thereof so authorized to be issued at any particular time, including any interest coupons to be attached thereto, and provisions for the issuance of certificates in registered form, provisions for the registration of any coupon certificates as to principal of loan and for the reconversion into coupon certificates of any certificates registered as to principal.

(3) The denomination or denominations of the certificates to be issued at any particular time, which may not be less than one hundred dollars ($100) but may be in sums of one hundred dollars ($100) or any suitable multiple thereof, and the place or places of payment of principal and interest thereof.

(4) The rate and rates of interest of the certificates to be issued at any particular time, payable semi-annually.

(5) The date of the certificates issued at any particular time and, within the limits prescribed by Article III, Section 34 of the Constitution of Maryland, the redemption dates of said certificates.

The resolution authorizing the issuance of said loan or any portion thereof shall set forth in detail the dates when any of the certificates representing said loan or any portion thereof are to be redeemed and the amount to be redeemed upon such dates, respectively. Said loan and certificates and every part thereof and the interest payable thereon shall be and remain exempt from State, County and municipal taxation.

(c) The Board of Public Works is hereby authorized and directed to have prepared proper Certificates of Indebtedness of the State in good and sufficient form to aggregate the amount of five million dollars ($5,000,000), as evidence of such loan; such Certificates of Indebtedness shall bear date as of the time of their issue as provided in subsection (b) of this Section. Each of said certificates shall be signed and countersigned in the manner prescribed by Section 3 of Article VI of the Maryland Constitution.

(d) In order to provide for the selling of the Certificates of Indebtedness aforesaid, to be issued under the provisions of this Section, the Board of Public Works is hereby directed to advertise once before the said Certificates of Indebtedness or any part thereof shall be issued in two newspapers published in the City of Baltimore and in such other manner as the Board of Public Works in its discretion may determine, that the Treasurer of this State will be in readiness at a time within twenty (20) days after the expiration of said notice to receive bids at such place or places as may be named in said respective advertisements for bonds or Certificates of Indebtedness issued under the provisions of this Section, under such regulations as may be made in the discretion of the Board of Public Works; and the accrued interest between the date of the bonds or Certificates of Indebtedness and the date of delivery of and payment for said bonds or Certificates of Indebtedness shall be adjusted with the purchaser thereof under such regulations as may be made in the discretion of the Board of Public Works; and upon the day mentioned in said advertisement as the date for opening the bids for the proposals thereby called for, they shall receive such sealed proposals for the purchase of as many of such bonds or Certificates of Indebtedness as may be mentioned or designated in said advertisement; and on the opening of such sealed proposals as many of said bonds or Certificates of Indebtedness as have been so bid for shall be awarded by the Board of Public Works, to the highest responsible bidder or bidders thereof for cash, if the prices bid are adequate, in the judgment of the Board of Public Works, and when two or more responsible bidders have made bids resulting in the same net interest cost to the State and such bids are the highest, then such bonds shall be awarded by lot to one of such responsible bidders; or if any insufficient price be bid for them, they may be subsequently disposed of under the direction of the Board of Public Works, at a private sale upon the best terms they can obtain for the same; provided they shall not be sold at private sale for less than par and accrued interest.

(e) So much thereof as may be necessary, shall be paid by the Treasurer of the State upon the warrant of the Comptroller out of the proceeds of the sale of said bonds or Certificates of Indebtedness for the payment of the expense of engraving, printing and other outlays connected with the issue of the loan hereby authorized, and for the payment of the advertising directed by this Section, and all other incidental expenses, connected with the execution of its provisions in connection with said loan.

(f) The actual cash proceeds of the sale of Certificates of Indebtedness to be issued under this Section shall be paid to the Treasurer of the State upon the warrant of the Comptroller, and such proceeds shall be used exclusively for the following purposes, to wit:

(1) The Comptroller immediately upon the sale of and payment for said certificates, first, shall return to and credit the Treasury for a sum equivalent to the amount expended, as provided in subsection (e) of this Act.

(2) The remainder of the proceeds of such loan shall be credited on the books of the State Comptroller, to be expended exclusively for the purpose of financing the costs of acquisition, improvements or rehabilitation of land for, and the acquisition, construction, reconstruction, extension and improvement of facilities in connection with the prevention, control and abatement of pollution of the waters of this State from abandoned deep or strip mines, including the prevention of drainage therefrom. The proceeds of such loan may be expended for the improvement or rehabilitation of land or the prevention of drainage from land occupied or degraded by abandoned strip mines or deep mines which is owned by the State of Maryland or by a political subdivision of the State,

or for the acquisition or improvement or rehabilitation of private land or the prevention of drainage from private land which is occupied or degraded by abandoned mines to carry out the purposes of this subheading; provided, however, that the proceeds shall not be used to improve or rehabilitate or prevent drainage from any land which is not owned by the State of Maryland or by a political subdivision of the State unless the owner of such land contributes to the cost thereof an amount at least equal to the increase in the value of such land which will result therefrom, such amount or the manner of determining such amount and the manner of payment thereof to be determined by the Secretary.

(g) Until all of the interest on and principal of any certificates issued under this Section have been paid in full, there is hereby levied and imposed an annual State tax on each $100 of assessable property at the rate to be determined in the following manner: on or before May 1, 1971, and on or before May 1, in each taxable year thereafter, the Board ofPublic Works shall certify to the governing bodies of each of the counties and Baltimore City the rate of State tax on each $100 of assessable property necessary to produce revenue to meet interest and principal which will be payable to the close of the next ensuing taxable year on all certificates theretofore issued or authorized by resolution of the Board of Public Works to be issued and the governing bodies of each of the counties and Baltimore City shall forthwith levy and collect such tax at such rate.

All matters committed by this section to the discretion of the Board of Public Works shall be determined by a majority of said Board.

678.

The Secretary shall have the power and authority to implement the provisions of this subheading including, but not limited to, the power and authority to backfill, grade, and revegetate abandoned strip mines, to seal abandoned deep mines and to control erosion and water drainage.

679.

Land acquired under the provisions of this subheading may be sold to a private person or retained by the State or transferred to a political subdivision of the State after such land has been rehabilitated and water pollution from the land has been controlled. All purchases, sales and transfers of land will be by an action of the Board of Public Works and the Board may promulgate regulations governing such transactions. The Board of Public Works may accept gifts of land from private citizens, groups, quasi-public organizations and political subdivisions of the State in order to accomplish the purposes of this subheading. Land thus acquired by the State, after rehabilitation and control of water pollution, shall be either sold or retained by the State or transferred to a political subdivision of the State as directed by the Board of Public Works. Any moneys received from the sale of land acquired hereunder shall be deposited in the Treasury and shall constitute a permanent special fund to be known as the "Abandoned Mine Drainage Capital Fund." The moneys in the Abandoned Mine Drainage Capital Fund from time to time may be expended for the same purposes as the proceeds of the loan authorized by this subheading, and such moneys shall be used for no other purpose.

680.

The Department may cooperate with other State agencies or political subdivisions of the State and expend funds jointly for water pollution control projects undertaken under the provisions of this subheading where the objectives of such projects may be better achieved or economies may be realized by such cooperation and joint action, or in instances where such cooperation and joint action is determined to be in the public interest.

681.

The Department may take advantage of any available federal program to augment the moneys made available to the Department under the provisions of this subheading.

682.

The Secretary may promulgate rules and regulations to implement the provisions of this subheading.

SEC. 2. And be it further enacted, That if any portion (word, sentence, paragraph, proviso or section) of this Act shall be held invalid for any reason, the remaining provisions shall remain in full force and effect, and such invalid portion shall be considered severed and deleted from this Act.

SEC. 3. And be it further enacted, That this Act shall take effect June 1, 1970.

Grant Agreement

THIS AGREEMENT, Made this 21st day of March, 1967, by and between the MARYLAND STATE DEPARTMENT OF HEALTH, an agency of the State of Maryland, the BOARD OF COUNTY COMMISSIONERS OF ALLEGANY COUNTY, a body corporate, and the CITY OF FROSTBURG, a municipal corporation.

WITNESSETH:

WHEREAS, there is an increasing problem of solid wastes disposal in Allegany County, and more particularly, in the area near the City of Frostburg of said County, which, if left uncontrolled, may become hazardous to the health and welfare of the residents thereof; and

WHEREAS, a solution to the aforesaid problem lies in the joint and mutual effort to conduct an appropriate solid wastes disposal facility in this area, and

WHEREAS, the parties hereto have prepared the details for such a solid wastes disposal facility to be operated over a three-year duration, for the purpose of obtaining data on which to base a suitable plan for permanent methods of solid wastes disposal; and

WHEREAS, the United States Department of Health, Education and Welfare has made available, under the Solid Wastes Disposal Act (Public Law 89-272), funds for research and demonstration programs relating to the operation of solid wastes disposal programs and the development and application of new and improved methods of solid wastes disposal facilities; and

WHEREAS, the State of Maryland, through the State Department of Health, has applied for a solid waste disposal demonstration grant in the amount of One Hundred Twenty-Six Thousand Three Hundred Eighteen Dollars ($126,318), to which the parties hereto will contribute, in the individual amounts hereinafter set forth, a total sum of Sixty-Five Thousand and Two Dollars ($65,002) for the purpose of carrying out the aforesaid survey plan, for the period November 1, 1966 through October 31, 1969; and

WHEREAS, the aforementioned application for said federal grant and the addenda attached thereto set forth the details of the said program, the respective responsibilities and obligations of the parties hereto, including the amounts which have been, or will be, budgeted and appropriated by the parties hereto for the purpose of carrying out the said survey, which said application and addenda are hereby made a contiguous part hereof.

NOW, THEREFORE, be it resolved that the parties hereto agree as follows:

1. A project demonstrating the feasibility of utilizing abandoned strip mines for use as solid wastes disposal sites will be conducted in Allegany County.

2. Pertinent research, investigations, tests, training, surveys and studies relating to the proper operation of a sanitary landfill and control of air pollution and water pollution in this area will be appropriately conducted, promoted and coordinated. In this connection, the State Department of Health will prepare the operational procedures and will provide needed technical services, coordination between agencies, data evaluation, laboratory support, basic training, and repair and maintenance beyond local capabilities. Allegany County, through its Health Department, will, in cooperation with the State Department of Health and the City of Frostburg, provide sites for location of the demonstration projects. The sites

provided will be available to the Maryland State Department of Health through October 31, 1969, for the conducting of this demonstration project.

3. Equipment, materials and supplies procured with grant funds shall, on completion of the study, become the property of Allegany County, except that recording and data collecting equipment shall become the property of the Maryland State Department of Health.

4. Immediately upon receipt of any part of said federal grant, the State Department of Health shall make payments thereunder pursuant to the details of the grant application, attached hereto.

5. When requested so to do, Allegany County and the City of Frostburg shall account for grant funds received by them to the State Department of Health in such a manner as may be prescribed by the Secretary of the United States Department of Health, Education and Welfare.

6. The City of Frostburg and Allegany County shall be participants in this demonstration project and shall make financial contributions, in quarterly installments beginning April 1, 1967, in the following manner for the three-year period of the demonstration project:

Allegany County	$500 per month
City of Frostburg	$600 per month

7. First publication of any data and information obtained shall be limited to those persons who have actually participated in the planning of this demonstration project.

This agreement shall remain in full force and effect through October 31, 1969; provided, however, that should the application for the solid waste demonstration project grant hereinabove referred to be not granted, then this agreement shall terminate automatically, and shall be void abinitio, without the necessity of any action being taken by any of the parties hereto.

IN WITNESS WHEREOF the parties hereto have caused this agreement to be properly executed.

Witness:

MARYLAND STATE DEPARTMENT
OF HEALTH

____

By_______________________
(Commissioner)

Witness:

BOARD OF COUNTY COMMISSIONERS
OF ALLEGANY COUNTY

____

By_______________________
(President)

Witness:

CITY OF FROSTBURG

____

By_______________________
(Mayor)

Approved as to form and legal sufficiency
this _______ day of ___________ _____

____
Special Attorney

Grant Agreement

THIS AGREEMENT, made this first day of ______________________________, by and between the MARYLAND STATE DEPARTMENT OF HEALTH, an agency of the State of Maryland, the BOARD OF COUNTY COMMISSIONERS OF ALLEGANY COUNTY, a body corporate, and the CITIES OF KEYSER AND PIEDMONT, WEST VIRGINIA, LUKE AND WESTERNPORT, MARYLAND, municipal corporations.

WITNESSETH:

WHEREAS, the States of Maryland and West Virginia are promulgating regulations prohibiting illegal, open burning and there is an increasing problem of solid wastes disposal in Allegany and Garrett Counties, Maryland, and Mineral County, West Virginia, particularly, in and near the cities of Keyser, Piedmont, Luke and Westernport of said counties, which, if left uncontrolled, may become hazardous to the health and welfare of the residents thereof; and

WHEREAS, a solution to the aforesaid problem lies in the joint and mutual effort to conduct an approved, sanitary landfill solid wastes disposal facility in this area, and

WHEREAS, the parties hereto have prepared the details for such a solid wastes disposal facility to be operated over a two-year duration for the purposes of obtaining data on which to base a suitable plan for permanent methods of solid wastes disposal; and

WHEREAS, the United States Department of Health, Education and Welfare has made available, under the Solid Wastes Disposal Act, (Public Law 89-272), funds for research and demonstration programs and the development and application of new and improved methods of solid wastes disposal facilities; and

WHEREAS, the State of Maryland, through the State Department of Health, has applied for a solid waste disposal demonstration grant in the amount of ____, to which the parties hereto will contribute, in the individual amounts hereinafter set forth, a total sum of twenty-one thousand, four hundred dollars for the purpose of carrying out the aforesaid survey plan, for the period November 1, 1967 through October 31, 1969; and

WHEREAS, the aforementioned application for said federal grant and the addenda attached thereto set forth the details of the said program, the respective responsibilities and obligations of the parties hereto, including the amounts which have been, or will be, budgeted and appropriated by the parties hereto for the purpose of carrying out the said survey, which said application and addenda are hereby made a continuous part thereof.

NOW, THEREFORE, be it resolved that the parties hereto agree as follows:

1. A project demonstrating the feasibility of utilizing abandoned strip mines for use as solid wastes disposal sites will be conducted in Allegany County or within a reasonable hauling distance to the participating municipalities.

2. Pertinent research, investigations, tests, training, surveys and studies relating to the proper operation of a sanitary landfill and control of air pollution and water pollution in this area will be appropriately conducted, promoted and coordinated. In this connection, the Maryland State Department of Health, as the responsible party, will prepare the operational procedures and will provide needed technical services, coordination between agencies, data evaluation, laboratory support, basic training, and repair and maintenance beyond local capabilities. Allegany County, through its Health Department, will, in cooperation with the State Department of Health and the cities of Keyser, Piedmont, Luke and Westernport,

provide sites for location of the demonstration projects. The sites provided will be available to the Maryland State Department of Health through October 31, 1969, for the conducting of this demonstration project.

3. Equipment, scales, materials and supplies procured with grant funds shall, on completion of the study, become the property of the Maryland State Department of Health for the perpetuation of a sanitary landfill site to serve participating parties and this general geographic area.

4. Immediately upon receipt of any part of said federal grant, the Maryland State Department of Health shall make payments thereunder pursuant to the details of the grant application, attached hereto.

5. When requested so to do, Allegany County, and the cities of Keyser, Piedmont, Luke and Westernport, shall account for grant funds received by them to the State Department of Health in such a manner as may be prescribed by the Secretary of the United States Department of Health, Education and Welfare.

6. The Cities of Keyser, Piedmont, Luke, Westernport and Allegany County shall be participants in this demonstration project and shall make a maximum financial contribution in quarterly installments beginning, ______________________ in the following manner for the two-year period of the demonstration project:

Allegancy County		per quarter
City of Keyser	$1,300.00	per quarter
City of Piedmont	$ 500.00	per quarter
City of Westernport	$ 750.00	per quarter
City of Luke	$ 125.00	per quarter

7. Publication of any data and information obtained shall be limited to those persons who have actually participated in the planning and operation of this demonstration project. Any use of this information must be released from the Maryland State Health Department.

8. Any contribution by any source other than the original contracting parties shall go toward defraying the original contributions by the same percentage amount that each participant paid.

This agreement shall remain in full force and effect through October 31, 1969; provided, however, that should the application for the solid waste demonstration project grant hereinabove referred to be not granted, then this agreement shall terminate automatically, and shall be void abinitio, without the necessity of any action being taken by any of the parties hereto.

IN WITNESS WHEREOF the parties hereto have caused this agreement to be properly executed.

Witness:

____

MARYLAND STATE DEPARTMENT
OF HEALTH

By ______________________________
Commissioner

Witness:

____

BOARD OF COUNTY COMMISSIONERS
OF ALLEGANY COUNTY

By ______________________________
President

Witness:	CITY OF KEYSER
______________________________	By ______________________________
Witness:	CITY OF PIEDMONT
______________________________	By ______________________________
Witness:	CITY OF LUKE
______________________________	By ______________________________
Witness:	CITY OF WESTERNPORT
______________________________	By ______________________________

ALLEN S. PAUCH, V. Pres.
Deer Park, Md.

JOHN ROSS SINES, Pres.
Oakland, Md.

HUBERT A. FRIEND, V. Pres.
Friendsville, Md.

County Commissioners of Garrett County

PHONE 334-3017

OAKLAND, MARYLAND 21550

HAROLD J. ADAMS, Clerk
Oakland, Md.

DWIGHT W. STOVER, Attorney
Oakland, Md.

January 12, 1968

Mr. Wilfred Shields, Jr., Acting Chief
Division of Solid Wastes
Maryland State Department of Health
2305 N. Charles Street
Baltimore, Maryland

Dear Mr. Shields:

COPY

At the regular meeting of the Board of County Commissioners of Garrett County on January 9, 1968 the following stated action was taken by the Board:

We, as the Governing Board of Garrett County are willing for Allegany County Health Department to establish and operate a waste disposal landfill in the Eastern part of Garrett County or Bloomington area to serve the following listed towns or communities: Luke, Maryland; Westernport, Maryland; Piedmont, West Va.; Keyser, West Va.; under the following conditions:

1. The pit will be operated and maintained to specifications of Garrett County Department of Health and the property owner.
2. That this in no way shall obligate Garrett County, financially.
3. If in the future, Garrett County would need the services of the Sanitary Landfill that we would be willing to pay our proportionate share of operating cost.

Very truly yours,

John Ross Sines
John Ross Sines,
President of Board

JRS/a

cc: Garrett County Department of Health, Oakland, Md.

JOB DESCRIPTION - LANDFILL SUPERVISOR

Qualifications: Landfill Supervisors shall be persons of integrity and having at least 4 years experience in the supervision of operators of one or more types of the following equipment: Track-type front end loader, track-type bulldozer, dump trucks, other type trucks and other types of equipment used in landfill operations or related construction work.

Duties: The main duties of this supervisory position are as follows:

1. Supervise the work of Landfill Operations to insure that all solid waste is properly received at the landfill site, weighed, dumped at the designated point, handled, compacted, and covered adequately in keeping with good landfill operating practices.

2. Supervise the work of Landfill Operators in conducting routine maintenance on tractors and other landfill equipment.

3. Supervise the operation of scales and associated data collection equipment.

4. Maintain records as required by landfill operating procedures and supervision and insure that the Landfill Operators maintain records as required.

5. Supervise the maintenance of the landfill properties.

6. Perform and supervise such other duties as may be assigned.

JOB DESCRIPTION - LANDFILL OPERATOR

Qualifications: Landfill Operators shall be persons of integrity and having at least 2 years experience in the operation of one or more types of the following equipment. Track-type front end loader, track-type bulldozer, dump trucks, other type trucks and other types of equipment used in landfill operations.

Duties: The main duties of this position are as follows:

1. Operate tractor to handle, compact, and cover refuse in accordance with good landfill procedures.

2. Conduct routine maintenance on tractor and other landfill equipment.

3. Operate scales and associated data collection equipment.

4. Maintain record as required by landfill operating procedures, and supervision.

5. Operate intermediate dumping receptacle and other landfill equipment.

6. Provide routine paper control maintenance.

7. Maintain office, tractor and total landfill site in a clean orderly condition.

8. Perform such other duties as may be assigned.

JOB DESCRIPTION - LANDFILL ASSISTANT

Place of Duty: Allegany County Landfill Project

Time of Employment: 5 day/40 hr. week - Normal hours would be 8:00 a.m. - 4:30 p.m.

Duties: General clean up and maintenance of landfill. This would include clean up of designated areas of paper and debris. Assist supervisor and landfill operators in light maintenance on landfill equipment. Filling in weight slips for trucks, general maintenance of office trailer and grounds and other general duties as assigned by supervision.

Special Requirements: Transportation to the job must be provided by the employee.

August 24, 1970

TO: All Landfill Project Employees
FROM: Dr. Elmer L. Hill, Deputy State Health Officer for Allegany County
SUBJECT: Realignment of Working Hours to Meet the Long-Term Landfill

As you may already know, under the new Federal Demonstration Grant, one stipulation is that it is necessary for Allegany County to compile complete operating plans for the future operation of the landfills.

At the present time several methods of financing are being devised and the operating procedures are being revised to meet the needs of the project. In order to meet the long-term planning objectives, it is necessary to set a policy with regard to the hours the sites are open, working hours, coffee breaks, lunch periods, etc.

Therefore, effective Monday, August 31, 1970, the following Work Schedule will prevail:

Site No. 1 (Frostburg) Open Hours 7:30 a.m. to 4:30 p.m.
Start Shift 7:30 a.m.
Coffee Break 9:30 to 9:45 a.m.
Lunch - Operator No. 1 12:00 noon - 12:30 p.m.
Operator No. 2 12:30 p.m. - 1:00 p.m. (if scheduled to work)
Scale Operator will be relieved by the Supervisor or other Operator for lunch from 12:30 to 1:00 p.m.

(note: Whenever possible a second tractor operator will work from 9:30 to 6:00 p.m.)

End Shift: 6:00 p.m.

Site No. 2 (Westernport) Open Hours 8:00 a.m. - 4:00 p.m.
Start Shift 8:00 a.m.
Coffee Break 9:30 a.m. - 9:45 a.m.
Lunch - Operator No. 1 12:00 noon - 12:30 p.m.
Scale Operator - 12:30 p.m. - 1:00 p.m.
(Relieved by other Operator)
End Shift: 4:30 p.m.

TABLE NO. 1
LABOR FORCE
FROSTBURG SITE NO. 1

JOB TITLE		YEAR AND NUMBER OF MEN IN EACH JOB CATEGORY 1967	1968	1969	1970	1971	OPTIMUM NUMBER OF MEN FOR 200 TONS/DAY AVERAGE
Landfill Supervisor**	Supervised Operation and maintenance and planned work tasks	–	1	1	1	1	1
Weighmaster	Weighed Delivery trucks and recorded refuse data. Emptied intermediate receptacle (dump truck) as required	1	1	1	1	1	1
Crawler Loader Operator	Spread and compacted refuse. Graded and compacted cover.	1	1	1	1	1	1
Crawler Dozer Operator	Spread and compacted refuse. Graded and compacted cover.	-	-	-	1	1	1
Utility Man	Provided reflief and backup replacements for weighmaster and tractor operators	-	-	1	1	1	1
Miscellaneous Laborers*	Policed general site and performed odd jobs.	-	-	-	-	-	2

*Miscellaneous laborers were provided on a part-time basis, as required, from various sources to perform a variety of tasks

**The Supervisor's time was divided between Frostburg Site No. 1 and Westernport Site No. 2.

TABLE NO. 2

OPERATOR WORK SCHEDULE

TIME SHEETS

ALLEGANY COUNTY LANDFILLS

FROSTBURG SITE NO. 1

Open 7:30 a.m. - 4:30 p.m.

Operators	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Hours
No. 1	10 hours 7:30-6:00	10 hours 7:30-6:00	10 hours 7:30-6:00	10 hours 7:30-6:00				40
No. 2			10 hours 7:30-6:00	10 hours 7:30-6:00	10 hours 7:30-6:00	10 hours 7:30-6:00		40
No. 3	10 hours 7:30-6:00	10 hours 7:30-6:00			10 hours 7:30-6:00	10 hours 7:30-6:00		40
No. 4	8 hours 9:30-6:00	8 hours 9:30-6:00	8 hours 9:30-6:00			8 hours 9:30-6:00	8 hours 9:30-6:00	40
No. 7							8 hours 8:00-4:30	
WESTERNPORT SITE NO. 2 Open 8:00 a.m. - 4:00 p. m.								
No. 5	8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30			8 hours 8:00-4:30	40
No. 6			8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30	40
No. 7	8 hours 8:00-4:30	8 hours 8:00-4:30			8 hours 8:00-4:30	8 hours 8:00-4:30	8 hours 8:00-4:30	40

FROSTBURG SITE NO. 1 AND WESTERNPORT SITE NO. 2

Operating Procedures

I. Hours of operation are:

  A. Site No. 1 (Frostburg) 7:30 a.m. - 4:30 p.m.

  B. Site No. 2 (Westernport) 8:00 a.m. - 4:00 p.m.

II. Days of operation are:

  A. Site No. 1 (Frostburg) Monday thru Saturday

  B. Site No. 2 (Westernport) Open 7 days/week

III. Operation Policies

Sites No. 1 and No. 2

Employees shall be present at their assigned place of duty no less than the operating hours as set forth in the operating procedures. Absence from assigned place of duty shall be only upon the issuance of verbal or written orders by the Supervisor or higher authority.

The first tractor operator of the day is responsible for servicing the tractor with sufficient fuel, oil, hydraulic fluid, coolant, lubrication, cleaning and freeing track and rollers of obstructions, and any other necessary item. The first tractor operator of the day must see that the dump truck receptacle is emptied as necessary. Also, he must oversee the dumping of loads of refuse that comes to the site during his period of duty and insure that the loads are placed in the proper location.

The tractor operator must direct the unloading of trucks and keep the smallest practical working face (dumping area). It is his responsibility to properly compact all refuse received during the day and to place a minimum of 6-inches of cover material over the refuse at the end of the working day. It is the tractor operator's responsibility to clean up and sufficiently cover all scattered debris. He shall be assisted in this work at the end of the day by the scale operator or other landfill employee(s). Any malfunctions or discrepancies must be reported as soon as practical to the Landfill Supervisor.

The scale operator is responsible for properly weighing contributing vehicles during his period of duty at the scales. The scale operator shall be responsible for recording the weighing data of each vehicle on the form prescribed. Also, he shall see that the scale, electric, and water systems are functioning properly. Any malfunction or discrepancy shall be reported to the Landfill Supervisor as soon as practical. The scale operator, at the latter part of the work shift, shall make sure the trailer is properly cleaned for the next shift. Cleaning shall be as follows:

1. Floor - free from excessive loose dust and dirt
2. Ash trays empty
3. Surfaces free of excessive dust
4. Bathroom fixtures clean and paper holders stocked
5. Soap available
6. Waste cans emptied
7. Windows - clean
8. Refrigerator - clean
9. Clothing, books and other items properly stored

After closing the main gate at the end of the day, the scale operator at site No. 1 shall check the dump truck intermediate receptacle. If it is more than 1/3 full he shall take the truck to the scales, weigh the refuse according to the accepted procedure, proceed to the dumping area and dump the refuse, return the truck to its parking position at the entrance. Under normal conditions this should be accomplished by 5 p.m. If the scale operator is still on duty he shall go to the dumping area and assist the tractor operator in paper control or other duties as required unless otherwise directed by the Landfill Supervisor.

After closing the main gate at the end of the day, the scale operator at site No. 2 shall go to the dumping area and assist the tractor operator in paper control or other duties as required unless otherwise directed by the Landfill Supervisor. Paper and weed control, grass mowing, snow removal and other duties will be assigned by the Landfill Supervisor on a random basis as the need arises.

IV. Emergency Procedures

A. Equipment Failure

In the event of equipment failure such as the tractor not operating properly, scales broken, electricity off, or other problems, the responsible employee shall contact the Landfill Supervisor immediately either by phone or by personal visit. If contact cannot be established within a reasonable amount of time, then contact the next higher authority (presently the Project Sanitarian or the Supervising Sanitarian). Keep a record of the time, date, and phone numbers or places that contact was attempted. If all the above efforts fail, the responsible employee shall use his best judgment in securing help from the manufacturing representative, utility company, or best equipped repair facility. Alternate or back-up machines may be received or rented from State or County Roads Department, Municipalities, Contracting Firms.

B. Accidents (General Rules)

1. If Bodily Injury is involved take steps immediately to secure help in the form of first aid, ambulance, or whatever the situation dictates.

2. If a fire exists, there is serious danger of fire, or volatile fluids are spilled, contact the nearest available fire company and explain the situation.

3. If the accident occurs on a state or county road notify the State Police and identify yourself as the driver of the Allegany County Landfill Project Vehicle and give the location of the accident. Notify the Landfill Supervisor or other project personnel immediately.

4. If the accident occurs within the confines of a landfill site, secure the names of the persons involved, license numbers, vehicle descriptions and notify your supervisors immediately.

C. Accidents (Specific Types)

1. Motor Vehicle (on site)

   a. Give aid or assistance if required

   b. Secure necessary data on other parties

   c. Contact supervisors

   d. Move vehicle if necessary and permission is granted

   e. Write down all details of accident

   f. Complete State of Maryland Motor Vehicle Accident Report Form.

2. Motor Vehicle (off site)

   a. Give aid or assistance if required

   b. Secure necessary data on other parties

   c. Contact State Police

   d. Contact Supervisors

   e. Move vehicle if necessary and permission is granted

   f. Write down all details of accident

   g. Complete State of Maryland Motor Vehicle Accident Report Form

D. Fire (General)

1. If very small, use proper type extinguishing agent that is available.

2. If fire is large or does not respond to use of extinguisher, immediately call nearest fire department. Control fire as much as possible until help arrives. Contact supervisors as soon as practical. Request ambulance if someone is injured, or significant danger of bodily injury exists.

E. Fire (Specific)

1. Refuse

a. In truck - dump or unload refuse in nearest safe, practical place to save the truck. Extinguish fire.

b. In pit area (Working face)

If refuse should become ignited spread refuse as quickly as possible to isolate the burning matter. Cover immediately with the most moist earth or cover material available to put out the fire. Later, windrow the burned matter to insure that all fire is extinguished. If the fire is not out or is too large for extinguishing, contact the fire department and supervisor immediately.

F. Explosion

Handle in accordance with fire and other applicable procedures keeping in mind that protection from bodily injury is of utmost importance.

G. Hazardous materials - If in doubt as to whether material is dangerous, or as to how it should be handled, contact County Health Authorities immediately.

H. Any Other Contingency

Use the basic ideas of Emergency Procedures and good sound judgment in dealing with the situation. If in doubt about the difficulty, procedure, or of possible controversial decisions contact your supervisors.

V. Inventory and Supplies

Records will be maintained by landfill personnel under the direction of the Landfill Supervisor and will include, but not be limited to, the following:

Key receipts
Clothing receipts
Housekeeping equipment
Tractor parts
Traffic counter parts
Pump parts
Truck parts
Scale parts
Fire and safety equipment
Hand tools

VI. The preceding rules are subject to change as necessary.

WELCOME TO ALLEGANY COUNTY LANDFILL NO. 2

The following rules of operation are necessary for the efficient operation of this landfill project. Your cooperation in abiding by these rules is greatly appreciated.

Rules of Operation

1) State laws require that all vehicles hauling materials that would be blown and/or fall upon a highway must be properly covered.

2) OBEY posted speed limits.

3) The Allegany County Landfill Project assumes no responsibility for accidents. Travel at your own risk on all roads leading to the landfill as well as the landfill site itself.

4) Cars and station wagons with small amounts of refuse please check with the scale operator.

5) NO HOT ASHES or burning material accepted.

6) NO FIREARMS or hunting permitted on the landfill property.

7) No scavenging or salvage operations permitted.

8) No trespassing after operating hours.

9) Refuse must be placed at the point designated by landfill personnel.

10) Prohibited items:
    (a) Motor vehicles or large portions thereof
    (b) Large stumps or tree limbs
    (c) Explosive materials or hazardous materials

11) Permits are required for non-county residents.

Hours of Operation

8:00 a.m. - 4:00 p.m.

NO CHARGE FOR ALLEGANY COUNTY RESIDENTS

This project is financed by the Board of Commissioners of Allegany County with Federal and State aid and operated by the Health Department as a service to this area. The Cities of Keyser and Piedmont, West Virginia pay a service fee to use this facility.

TABLE NO. 3
EQUIPMENT
FROSTBURG SITE NO. 1

ITEM AND DESCRIPTION	TASK	YEAR AND NUMBER OF UNITS IN EACH CATEGORY 1967	1968	1969	1970	1971	OPTIMUM UNITS FOR 200 TONS/DAY AVERAGE
80 h.p. Crawler Loader with 1½ cubic yard bucket - 21,000 pounds	Spread and compacted refuse and cover and maintained on-site roads.	1	(Moved to Site No. 2 in 1968)				-
185 h.p. loader with 3 cubic yard bucket - 44,000 pounds	Spread and compacted refuse and cover material	-	1	1	1	1	1
195 h.p. crawler dozer with blade - 54,000 pounds	Spread and compacted refuse	-	-	-	1	1	1
115 h.p. crawler loader	Back-up use for spreading and compacting refuse and cover		Rented as Required				-
5-ton dump truck (or equivalent)	Intermediate receptacle that received householder devliered refuse.	1	1	1	1	1	1
Tandem dump truck	Hauled material for road maintenance and cover when needed. Back-up use as intermediate receptacle for householder delivered refuse.	-	-	1	1	1	1
3/4-ton pick-up truck	Used for liaison activities between sites Nos. 1 & 2. Also used in area windblown debris control program.	-	-	-	1	1	1

TABLE NO. 3
EQUIPMENT
FROSTBURG SITE NO. 1
Page 2

ITEM AND DESCRIPTION	TASK	YEAR AND NUMBER OF UNITS IN EACH CATEGORY 1967	1968	1969	1970	1971	OPTIMUM UNITS FOR 200 TONS/DAY AVERAGE
1,000 gallon water truck with pump and hose.*	Fire and dust control	-	1	1	1	1	1

NOTE: In addition to back-up equipment, auxiliary items necessary for road and drainage ditch maintenance and fill completion were borrowed from the county or rented as required.

* A water tank mounted on the flat bed of a trailer was used for 1968 and 1969. A truck was acquired in 1969 and used for the duration of the project.

EQUIPMENT RENTAL
Frostburg Site #1 and Westernport Site #2

1966 - 1967

Site #1	Equipment rental which included building access and exit roads, grading, stabilization and installation of culverts		$2,300

1967 - 1968

Site #1	Snow Removal	$ 30.00	
	Snow Removal	10.00	
	Dozer & Driver for Ramp Improvement	307.40	
		$347.40	
Site #2			
	Diversion Ditches and Clearing	$598.00	
	Hauling dirt - 12 hours	125.00	
	Road Construction	495.00	
	Backhoe	40.00	
	Trenching	368.00	
		1,626.00	1,973.40

1968 - 1969

Site #1			
	Snow Removal	$ 35.15	
	Snow Removal	40.00	
		75.15	
Site #2			
	Rented Dozer 16 hours	$240.00	
	Site Improvement (roads)	128.00	
	Site Improvement (roads)	122.00	
		490.00	565.15

1969 - 1970

Already included in report

Site #1
1966 - 1967

COST DATA - FROSTBURG SANITARY LANDFILL

I. Capital Costs:

A.	Site Survey (25 acres)	$ 750
B.	Building & Access Exit Roads (grading, stabilization, culverts)	2,300
C.	Trench Bottom Stabilization	500
D.	Diversion Ditches	200
E.	Gates and Fences	248
F.	Administrative Facilities	
	1. Trailer (5 year amortization)	764
	2. Water Supply System	698
	3. Electrical System	590
	4. Sewage Disposal System	355
	5. Scales (foundation & print-out system, amortized 5-year period)	1,307
G.	Equipment Repair Shed	2,400
H.	Intermediate Receptacle	165
I.	Equipment - Bulldozer - 80 HP Front-End Loader (amortized 5 years)	3,900
	Subtotal	$14,177

II. Operating Costs:

A.	Fuel and Miscellaneous Costs	870

Site #1
1966 - 1967

FROSTBURG SANITARY LANDFILL (Cont.)

III.	Ground Rent:		1,050
		Subtotal	$ 1,920
IV.	Personnel:		
A.	Chief, Division of Solid Wastes, 25% time on project as Project Director		3,648
B.	Sanitarian V, 100% time on Project, to function as Principal Investigator		12,932
C.	Public Health Aide, 100% time on project to function in setting up physical facilities and supervise operation of project		5,317
D.	Secretary, 25% time on project		1,121
E.	Tractor Operator, 100% time on project		5,040
		Subtotal	$28,058

1966 - 1967
GRAND TOTAL $44,155

Tonnage 16,000
Cost/Ton = $2.76

Site #1
1967 - 1968

COST DATA - FROSTBURG SANITARY LANDFILL

I. Operating Costs:

A.	**Equipment (Amortized):**	
	1. 185 HP Front-End Loader	7,900
	2. Trailer amortized	595
	3. Scales amortized	1,032
	4. 80 HP Front-End Loader - to Westernport Site	
	Subtotal	9,527
B.	**Repairs to Equipment:**	
	1. 185 HP Front-End Loader	863
	2. Receptacle Trucks	337
	3. Water System	15
	4. Trailer	41
	5. Scales	154
	Subtotal	1,410
C.	**Supplies:**	
	1. Fuel and Lubricants, Fitters, etc.	1,041
	2. Miscellaneous	785
	3. Electricity	530
	4. Telephone	294
	5. Travel	1,500
	Subtotal	4,150
D.	**Site Improvement:**	
	1. Road stone, fences, dynamiting, concrete	821
E.	**Engineering Costs:**	
	1. Reproductions	60
	2. Survey	130
	Subtotal	190
F.	**Ground Rent:**	1,050
	Subtotal	17,148

Site #2
1967 - 1968
COST DATA - WESTERNPORT SANITARY LANDFILL

I. Capital Costs (Initial Site Preparation):	
A. Site Survey (7) acres)	84
B. Building access and exit roads, including:	
1. Grading, stabilization, culverts	
2. Diversion ditches	
3. Gates and fences	2,743
	2,827
C. Capital Costs (Administrative Facilities):	
1. Trailer (5 year amortization)	473
2. Water supply system	967
3. Electrical System	224
4. Sewage Disposal System	412
5. Scales	7,119
6. Equipment Shed	2,150
	11,345
II. Operating Costs:	
A. Fuel Costs	90
B. Engineering Costs	100
C. Miscellaneous	170
D. Repairs to Equipment	178
	538
III. Equipment Costs:	
A. 80 HP Front-End Loader	3,160
IV. Filter Bed Construction:	319
V. Travel:	2,000
Subtotal	20,189

FROSTBURG SITE NO. 1 and WESTERNPORT SITE NO. 2

1967 - 1968

II. Personnel (Continued)　　　VI. Personnel (Continued)

Site #1 Time Effort - 66-2/3%		Site #2 Time Effort - 33-1/3%	Total
Project Director	2,218.67	1,109.33	3,328
Principal Investigator	4,586.00	2,293.00	6,879
Sanitarian I	4,606.00	2,303.00	6,909
Stenographer	539.33	269.67	809
*Landfill Supervisor	3,848.00	1,924.00	5,772
**1½ Tractor Operator		6,925.00	6,925
Secretary	628.67	314.33	943
Fringe Benefits	1,683.33	841.67	2,525
Subtotals	$ 18,110.00	15,980.00	34,090

*One "man power" tractor operator at Site #1 furnished from federally sponsored Work Experience Program at no cost to the Project.

**Tractor Operator also serves as scale man on both sites.

1967 - 1968 GRAND TOTALS:

Site #1: $ 35,258.00 Tonnage 19,365 Cost/Ton $1.88	Site #2: $ 36,169 Cost/Ton could not be figured because the scales were not in operation during this period.

Site #1
1968 - 1969

COST DATA - FROSTBURG SANITARY LANDFILL

I. **Operating Costs:**

A. **Equipment (amortized):**

1.	185 HP Front-End Loader	6,241
2.	Trailer	486
3.	Scales	826
4.	Dump Truck Surplus not amortized	250
5.	Traffic Counter not amortized	470
	Subtotal	8,273

B. **Repairs to Equipment:**

1.	185 HP Front-End Loader	2,080
2.	Receptacle Trucks	88
3.	Dump Trucks	22
4.	Scales	7
	Subtotal	2,197

C. **Supplies:**

1.	Fuel and Lubricant and Filters	2,693
2.	Telephone	234
3.	Electricity	491
4.	Miscellaneous	160
	Subtotal	3,578

D. **Site Improvement:**

1.	Stone, fence, pipe snow removal	560

E.	Ground Rent:	1,050
	Subtotal	15,658

Site #2
1968 - 1969

COST DATA - WESTERNPORT SANITARY LANDFILL

I.	Capital Costs:		
	A.	Scale Installation	1,444
	B.	Trailer amortized	360
	C.	80 HP Front-End Loader	2,456
	D.	Filter Beds (sand, stone, lumber, concrete)	962
			5,222
II.	Repairs to Equipment:		
	80 HP Front-End Loader		1,122
III.	Operating Costs:		
	1.	Fuel & Lubricant	560
	2.	Telephone	179
	3.	Electricity	785
	4.	Miscellaneous	170
			1,694
IV.	Site Maintenance:		
	1.	Pipe, snow fence, gravel, sand	655
V.	Engineering Cost:		6
		Subtotal	8,699

FROSTBURG SITE NO. 1 and WESTERNPORT SITE NO. 2

1968 - 1969

II. Personnel (Continued)		VII. Personnel (Continued)
Site #1 Time Effort 66-2/3%		Site #2 Time Effort 33-1/3%
Project Director	2,218.67	1,109.33
Principal Investigator	4,586.00	2,293.00
Sanitarian II	2,133.33	1,066.67
Clerk Typist I	539.34	269.67
Secretary	628.66	314.33
* Landfill Supervisor	2,886.00	2,886.00
** Tractor Operator		4,160.00
Tractor Operator	4,160.00	
Tractor Operator	4,160.00	
Tractor Operator	4,160.00	
Tractor Operator		4,160.00
Fringe Benefits	2,225.33	1,112.67
Cost Data (Sites 1 & 2)	15,658.00	8,699.00
	43,355.33	27,070.67

Total Combined Cost= 43,355.33 + 26,070.67 =	69,426.00
Miscellaneous Operating Expenses (Both Site)	13,076.00
Travel (Both Sites)	1,040.00
Total Expenses (Both Sites)	$83,542.00
Total Costs (Both Sites)	83,542
Total Tons (Both Sites)	62,807
Cost per ton	$ 1.33

Site #1
1969 - 1970

COST DATA - FROSTBURG SANITARY LANDFILL

I. Operational:		
A. Consultant Services:		2,450
B. Equipment (Amortized):		
1. 185 HP - Frost-end Loader		5,008
2. Trailer		390
3. Scales		665
4. Pick-Up Truck		600
	Subtotal	9,113
C. Repairs to Equipment:		
1. 185 HP - Front-end Loader		11,570
2. Emergency Equipment Rental		6,893
3. Trucks		200
4. Traffic Counter		18
5. Scale (Hammers)		206
	Subtotal	18,887
D. Supplies:		
1. Fuel		3,500
2. Telephone		357
3. Electricity		700
4. Miscellaneous		957
	Subtotal	5,514
E. Site Improvement:		
1. Road Improvement		2,800
F. Research Costs:		
1. Physical Modifications - cement, steel pipe, drilling lumber, specialty steel, plastic pipes		3,177
2. Testing Equipment		2,565
3. Fertilizer, seed, labor (use of disc, line trucks, etc.)		960
	Subtotal	$3,525

Site #1
1969 - 1970

FROSTBURG SANITARY LANDFILL (Cont.)

G.	Engineering Cost:	
	1. Surveying	1,380
H.	Industrial Filter Bed Costs:	897
I.	Tours:	
	Bus Service, Hotel & Conference Rooms, Display Booths, Photographic Supplies	1,558
J.	Travel:	4,000
	Subtotal	7,835

K. Personnel:

	Time Effort	
Project Director	20%	3,705
Principal Investigator	20%	3,247
Sanitarian II	20%	1,968
Public Health Engineer II	60%	6,739
Landfill Supervisor	100%	7,205
*Tractor Operator	100%	5,476
Tractor Operator	100%	5,476
Tractor Operator	100%	5,476
Sanitarian II	75%	7,825
Sanitarian IV	20%	2,951
Fringe Benefits		2,114
	Subtotal	$52,182

* Tractor Operators also serve as scale men.

GRAND TOTAL $103,033

Tonnage 77,714
Cost/Ton $1.33

Site #1
1970 - 1971

COST DATA - FROSTBURG SANITARY LANDFILL

I. Operational:

A. Consultant Services:

1.	Technical Writing Services	5,000
2.	Leachate pump and gas sampling tubes	470
	Subtotal	$5,470

B. Equipment (Amortized):

1.	185 HP Front-End Loader, AC-HD 12	4,004
2.	Office Trailer	312
3.	Truck Scales	523
4.	Pick Up Truck, original cost $3,000, depreciated over five years, purchased 1969 - 1970	1,820
5.	2 Ton Dump Truck, Army Surplus, (Refuse Receptacle) out of service, original cost $65.00	00
6.	5 Ton Dump Truck, Army Surplus, 6 X 6 Tandem, Original Cost $300.00, not amortized	300
7.	2 Ton Used Dump Truck, purchased 12/71	1,200
	Subtotal	$8,159

C. Repairs to Equipment:

1.	185 HP Front End Loader, HD 12	$ 1,356
2.	Emergency Equipment Rental	20,713
3.	2 Ton Dump Truck	429
4.	5 Ton Dump Truck	344
5.	Pick Up Truck	350
6.	Truck Scales	136
7.	Water Supply Pump	59
	Subtotal	$23,387

D. Supplies:

1.	Diesel Oil and Lubricants	6,864
2.	Electricity	616
3.	Phone	249
4.	Miscellaneous	1,223
	Subtotal	$17,743

Site #1
1970 - 1971

FROSTBURG SANITARY LANDFILL (Cont.)

E. Travel:

1. Meals and Lodging	Subtotal	$4,500

F. All Other Expenses:

1. Two Landfill Tours		381
2. Lease of Ground		2,175
3. Final Site Improvement including earth moving, preparation of seed bed, lime, fertilizer, and seed		33,800
4. Road Improvements		381
	Subtotal	$36,737

G. Personnel:	Time Effort		
Project Director	20%		3,008
Principal Investigator	20%		3,377
Public Health Engineer V	60%		9,540
Sanitarian III	20%		2,435
Landfill Supervisor	100%		6,642
Tractor Operator	100%		5,470
Tractor Operator	100%		5,470
Tractor Operator	100%		5,470
Tractor Operator	100%		5,207
Sanitarian III	15%		1,760
Sanitarian IV	10%		1,535
Secretary I	50%		2,572
Fringe Benefits			2,624
		Subtotal	$55,110

GRAND TOTAL $151,106

Tonnage 74,000
Cost/Ton $2.15

BRUCE D. MARTIN
BOX 234
LEONARDTOWN, MARYLAND 20650

(301) 769-3298
(301) 994-1600

May 20, 1971

Mr. Charles M. Kenealy, Chief
Division of Solid Wastes
Maryland State Department of
Health and Mental Hygiene
2305 North Charles Street
Baltimore, Maryland 21218

Dear Mr. Kenealy:

Relative to your request of May 11, 1971, I am enclosing a copy of the report, "Geology and Hydrology of the Hoffman Sanitary Landfill, Allegany County, Maryland." This report is similar to the one submitted in January, 1971 except that it is brought up-to-date because of new material.

If you have any questions concerning the report, please contact me.

Yours sincerely,

Bruce D. Martin

Bruce D. Martin, Ph.D.
Consulting Geologist

BDM/smh

Enclosure

GEOLOGY AND HYDROLOGY OF THE FROSTBURG SANITARY LANDFILL

SITE NUMBER I

ALLEGANY COUNTY, MARYLAND

I. Introduction

Specially designed observation wells were installed at the Frostburg landfill site to aid in sample collection, and to observe, measure, and test a variety of characteristics related to the geology and hydrology of sanitary landfills placed in old strip mines. Two basic well types were installed: one type on the surface of the landfill penetrating all layers of previously compacted and covered trash, and the other adjacent to the landfill in a geologic downdip position penetrating undisturbed strata. The two basic areas for well locations were designed for essentially independent objectives and methods of data collection, but as the research progressed, overlap occurred in the areas of data presentation.

Both types of wells aided in carrying out the following activities:

1. The measurement of ground water and/or leachate level fluctuations.
2. The measurement of air and water temperatures inside each well.
3. The observation of liquid flow patterns by means of tracers.
4. The sampling of gases and liquids for laboratory analysis.

Additionally, the wells on the landfill were fitted at the ground surface with moveable concrete collars which allowed for the measurement of the percent of landfill settlement.

II. Well Installation

A. Groundwater Observation Well (Figure No. 4)

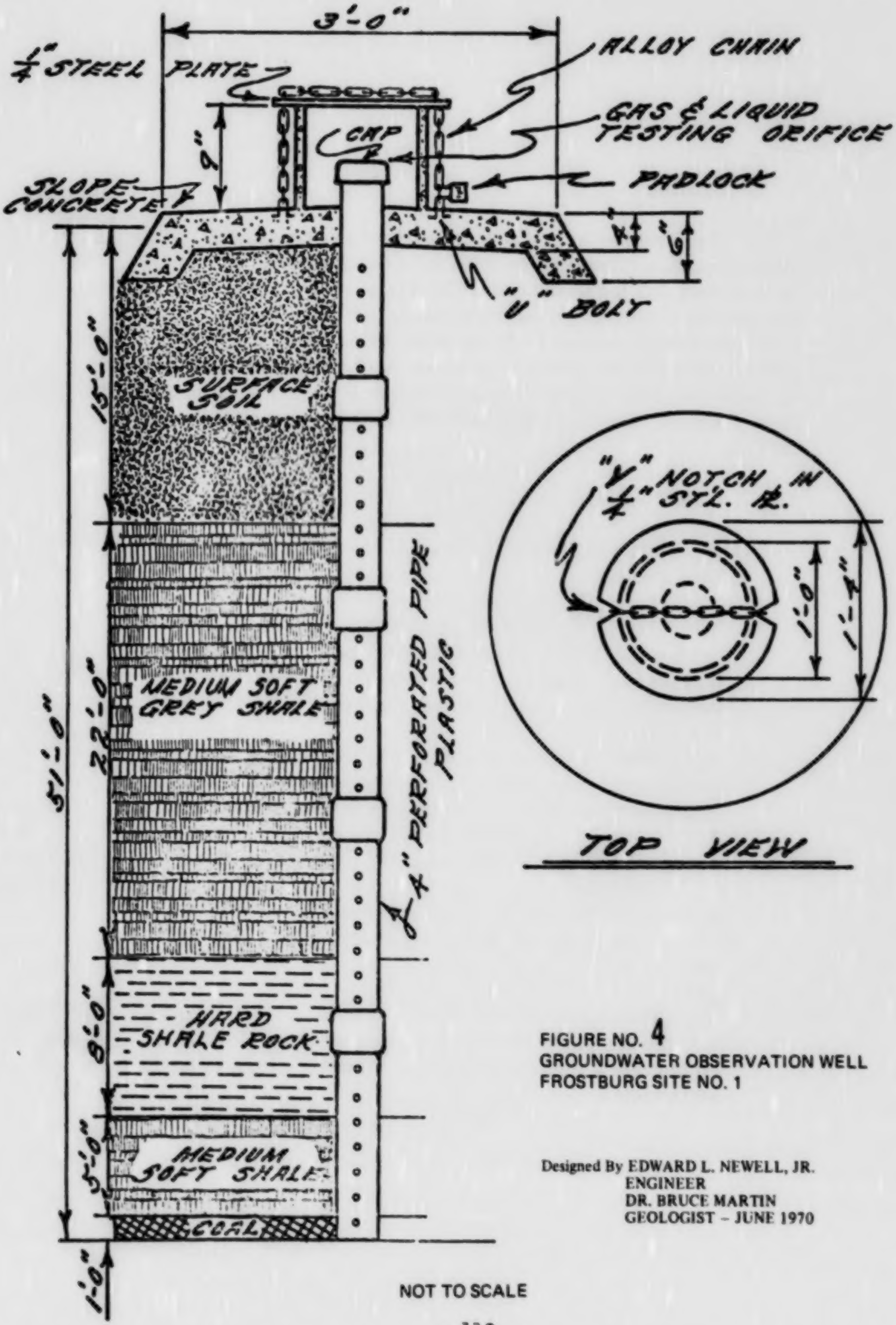
3'-0"
1/4" STEEL PLATE
ALLOY CHAIN
GAS & LIQUID TESTING ORIFICE
CAP
9"
PADLOCK
SLOPE CONCRETE
4"
6"
"U" BOLT
15'-0"
SURFACE SOIL
22'-0"
MEDIUM SOFT GREY SHALE
51'-0"
4" PERFORATED PIPE PLASTIC
8'-0"
HARD SHALE ROCK
5'-0"
MEDIUM SOFT SHALE
COAL
1'-0"
"V" NOTCH IN 1/4" STL. PL.
1'-0"
1'-4"
TOP VIEW

FIGURE NO. 4
GROUNDWATER OBSERVATION WELL
FROSTBURG SITE NO. 1

Designed By EDWARD L. NEWELL, JR.
ENGINEER
DR. BRUCE MARTIN
GEOLOGIST – JUNE 1970

NOT TO SCALE

1. Drilling

Ten observation wells were drilled on May 14, 1970, (Figure No.5). These wells ranging in depth from 51 feet to 86 feet were drilled to the top of the Tyson coal seam for which the coal was removed in the strip mine. (Figure No.6). Wells 1 through 8 were placed as close to the filled pit as possible and penetrated complete geologic sections; wells 9 and 10 were located to facilitate observations of ground water levels and movement away from the pit. Water was encountered in all ten wells at the time of drilling.

2. Well Construction

a. The wells were drilled into the coal seam, but not through it.

b. The holes were cased with four inch diameter perforated PVC (polyvinylchloride) pipe with 10, one-half inch openings per foot of pipe. These perforations permitted free water flow into the wells.

c. Concrete collars surrounded the casings at ground level to prevent surface water from entering the wells. Removeable plastic caps covered the tops of the casings. For additional protection against vandalism, locked steel covers protected the well caps and concrete collars.

c. Signs marked the sites of the wells to aid in their location in case they were obscured by high grass or snow.

e. Bench marks were established on wells 2, 3 and 5 to facilitate in the determination of changing elevations on landfill observation wells A, B and C, owing to landfill settlement.

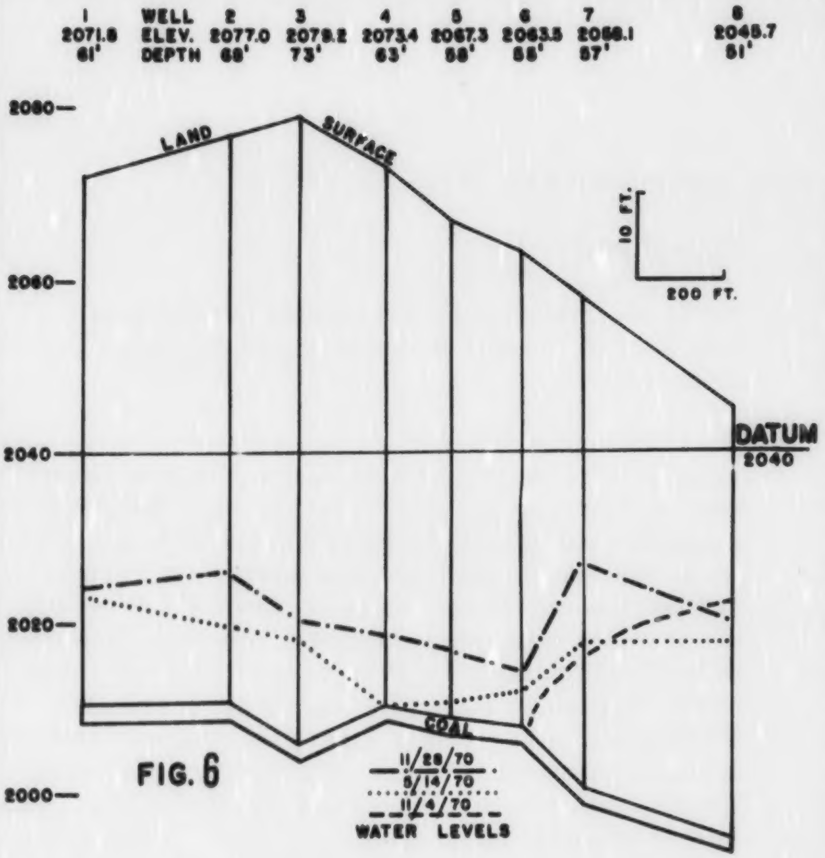

FIG. 6

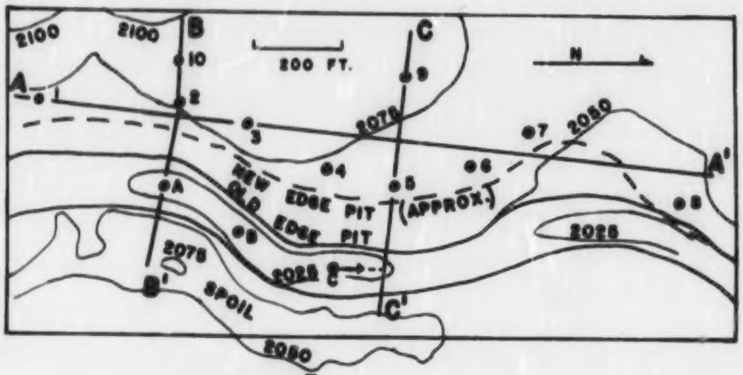
2100
2100
B
10
C
9
200 FT.
N
A
1
2
3
2075
7
2050
4
5
6
A'
A
NEW EDGE PIT (APPROX.)
OLD EDGE PIT
8
B
2025
2075
2025
C
B'
SPOIL
C'
2050

FIGURE NO. 5
CONTOURS IN PIT AND SPOIL AREA
(PRE–LANDFILL)
FROSTBURG SITE NO. 1

EDWARD L. NEWELL, JR. M.C.E.
BRUCE D. MARTIN, PH.D.
DEC. 1970

B. Landfill Observation Well (Figure No. 7)

1. Pile-Driving

Three observation wells were placed in the finished section of the landfill on August 28 and 29, 1970 (Figure No. 5).

These were pile-driven to the top of the same Tyson coal seam as were the ground water wells. Wells A and B were 44 feet deep and well C was 33 feet. The initial procedure was to drill the holes similar to the groundwater observation wells and then insert steel casings. Drilling through the refuse, using standard rotary drill air pressure methods, presented no problem. However, difficulty occurred at the 20 foot depth in the extraction of the drill rod. Refuse filled behind the rod blocking its removal. After several hours, the drill was worked loose and removed. Because of the drilling problems, the steel pipe was then pile-driven into the landfill. This method proved to be successful. A specially designed toothed drilling cone, locally made, was then used to penetrate the landfill to the Tyson coal seam. No leachate was encountered at the time of well installations. However, within 24 hours after installation, three (3) feet of leachate, rich in greases and oils with an odor of anaerobic decomposition, was measured in landfill well A, but wells B and C were still dry.

2. Landfill Well Construction

a. The wells were driven to the coal seam, but not through it.

b. The holes were cased with four-inch diameter standard steel pipes with ¼ inch wall thickness. Four 10-foot sections of pipe had six rows of 3/16-inch diameter holes to allow leachates and gases to enter the well.

c. Two 10-foot sections were graduated with marks of tenths of feet for determination of land settlement.

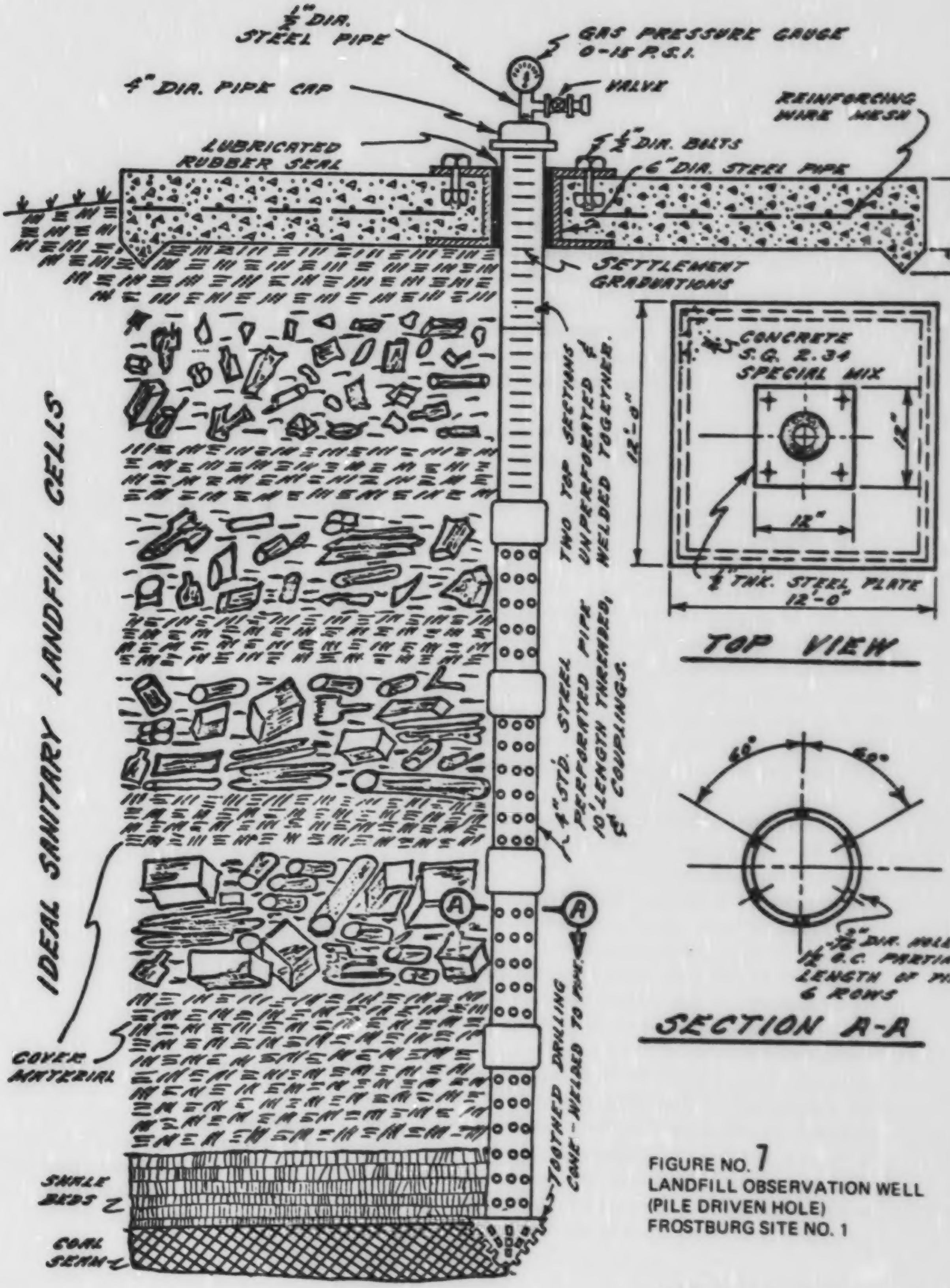
½" DIA. STEEL PIPE
GAS PRESSURE GAUGE 0-15 P.S.I.
4" DIA. PIPE CAP
VALVE
REINFORCING WIRE MESH
LUBRICATED RUBBER SEAL
½" DIA. BOLTS
6" DIA. STEEL PIPE
12"
6"
SETTLEMENT GRADUATIONS
IDEAL SANITARY LANDFILL CELLS
TWO TOP SECTIONS UNPERFORATED & WELDED TOGETHER.
4" STD. STEEL PERFORATED PIPE 10' LENGTH THREADED, & COUPLINGS.
CONCRETE S.G. 2.34 SPECIAL MIX
12'-0"
12"
12"
½" THK. STEEL PLATE 12'-0"
TOP VIEW
60°
60°
A
A
3/16" DIA. HOLES 1½" O.C. PARTIAL LENGTH OF PIPE. 6 ROWS
SECTION A-A
COVER MATERIAL
TOOTHED DRILLING CONE - WELDED TO PIPE.
SHALE BEDS
COAL SEAM

FIGURE NO. 7
LANDFILL OBSERVATION WELL
(PILE DRIVEN HOLE)
FROSTBURG SITE NO. 1

NOT TO SCALE

Designed By E. H. NEWELL, JR.
ENGINEER
SEPT 1970

d. Steel, rubber lined collars were placed around the casings. A ten-foot section of pipe was lubricated with silicone stopcock lubricant.

e. A concrete mixture with a specific gravity of 2.34 was poured around the collars and over the reinforcement bars and mesh to form the collar

f. A 4-inch to ½-inch pipe reducer cap was placed on top of the casing.

III. Ground Water Movement (Ground Water Observation Wells 1 through 10):

The driller's log and water level measurements were used to construct a number of diagrams useful in determining various aspects of the geology and hydrology of the area. Two cross sections B-B' and C-C' (Figures Nos. 8 and 9) show the section at right angles approximately to cross section A-A' (Figure No. 5). Water levels were shown for the dates May 14, 1970, and November 28, 1970; the former indicates a fairly high water condition near the end of the spring season and the latter shows levels responding to the first heavy and prolonged rain after the summer dry period. In addition, water levels for other select periods are depicted.

A three-dimensional fence diagram of the west wall is shown in Figure No. 10 . Well Number 1 was excluded as it would have obscured well number 10. As may be noted, a fairly high water level existed on May 14, 1970, and was at a maximum for the period of November 28, 1970. On November 4, 1970, the period of low water occurred, and was at a minimum when the water was measured in wells 7 and 8 only. (Figure No. 6). Groundwater movement is indicated by the strike (azimuth) and dip (gradient) of the beds as being west into Georges Creek Basin or syncline (Figure No. 11). The gradients of the water surfaces are shown in Figures Nos. 6 , 8 , and 9. The east-west gradients were very low, averaging 1 foot per 100 feet; on these sections the indicated direction of flow is either into or away from the pit depending on the time of the year; i.e., seasonal fluctuation directly related to surface precipitation. The true direction of flow (Figure No. 6) was actually from either side of the line of section parallel to cross section A-A' towards wells 4 and 5. Probably the flow direction then was both to the west (Figure No. 11) in the vicinity of well 6 and into undersaturated beds below the Tyson coal via vertical fractures. Because water did accumulate in wells 1 through 10 indicates that leakage into the lower undersaturated beds was probably less compared to the westward downdip flow in the beds above the Tyson

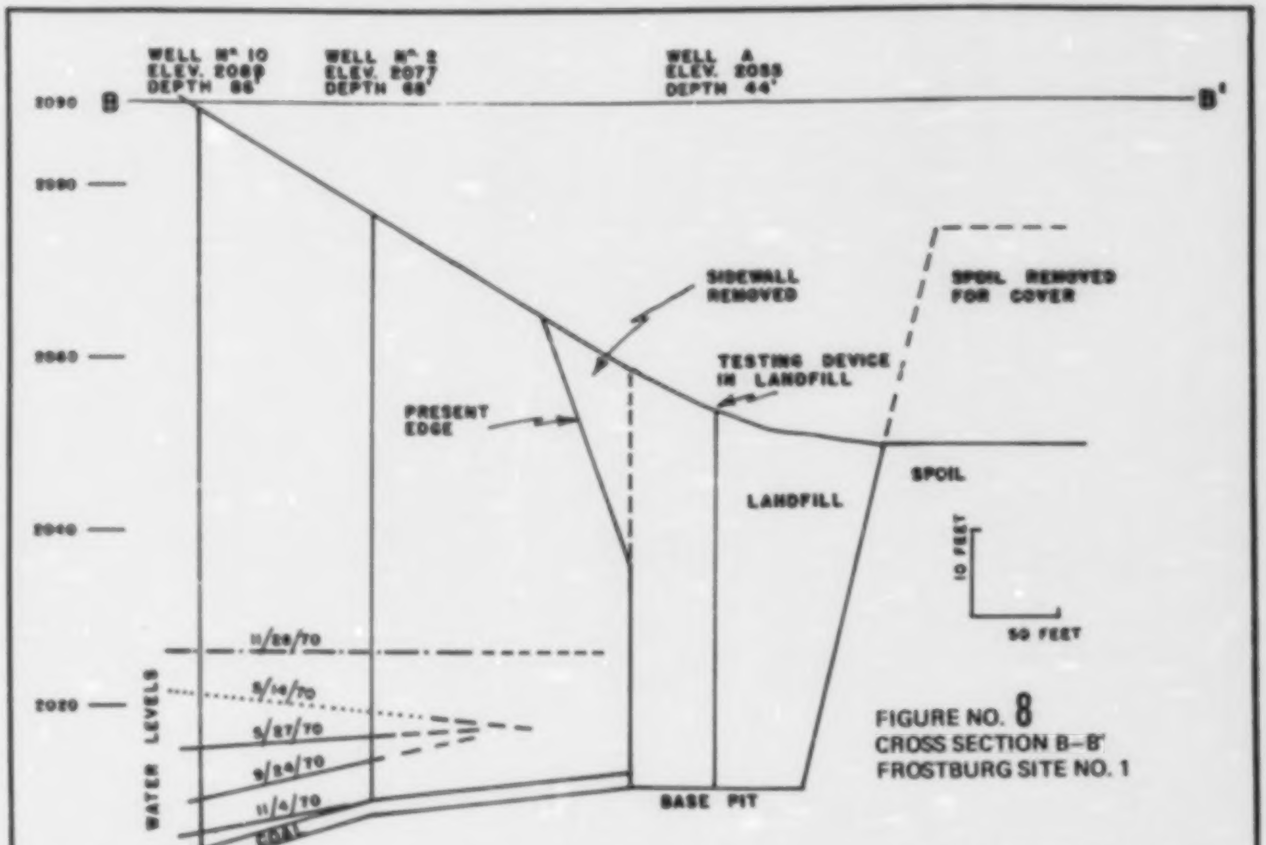
WELL N° 10
ELEV. 2089
DEPTH 86'
WELL N° 2
ELEV. 2077
DEPTH 68'
WELL A
ELEV. 2053
DEPTH 44'
B
B'
2090
2080
2060
2040
2020
2000
SIDEWALL REMOVED
SPOIL REMOVED FOR COVER
TESTING DEVICE IN LANDFILL
PRESENT EDGE
LANDFILL
SPOIL
10 FEET
50 FEET
11/20/70
5/14/70
5/27/70
9/24/70
11/4/70
COAL
WATER LEVELS
BASE PIT

FIGURE NO. 8
CROSS SECTION B–B'
FROSTBURG SITE NO. 1

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BRUCE D. MARTIN, PH.D.

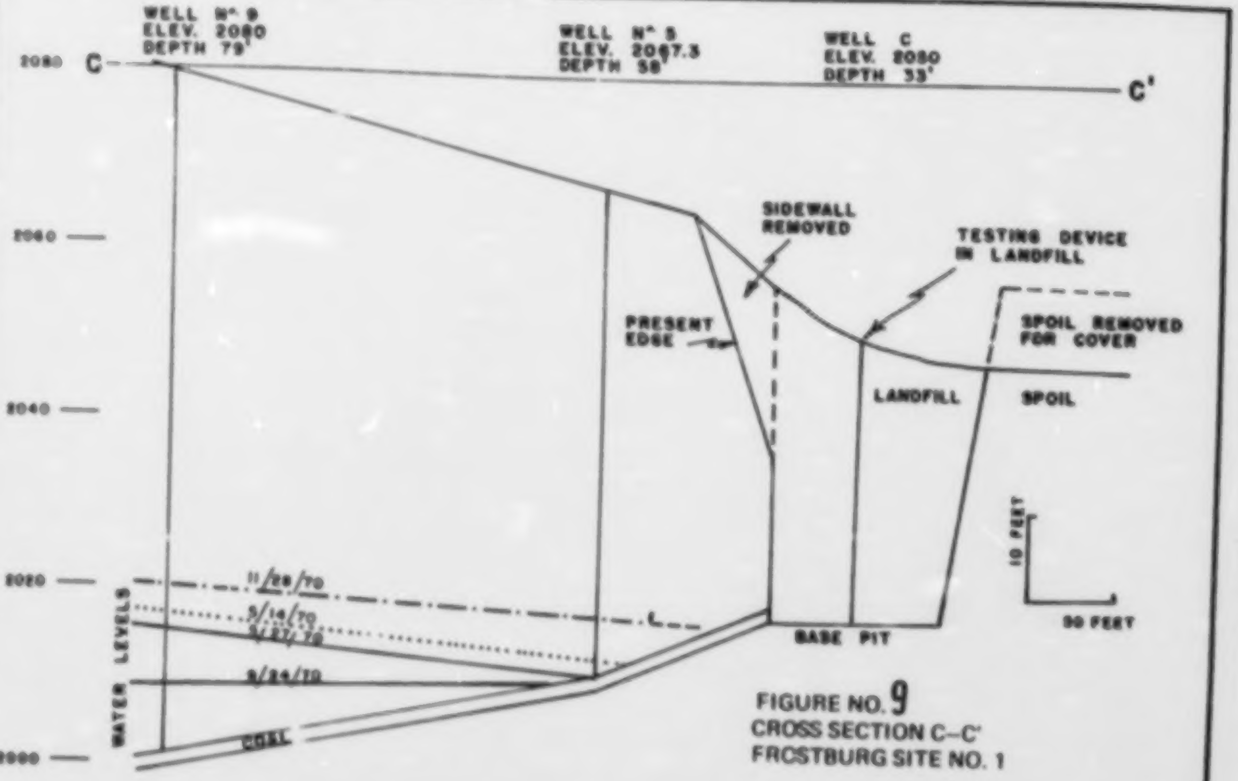
WELL N° 9
ELEV. 2080
DEPTH 79'
WELL N° 5
ELEV. 2067.3
DEPTH 58'
WELL C
ELEV. 2050
DEPTH 33'
C
C'
2080
2060
2040
2020
2000
SIDEWALL REMOVED
TESTING DEVICE IN LANDFILL
PRESENT EDGE
SPOIL REMOVED FOR COVER
LANDFILL
SPOIL
BASE PIT
10 FEET
50 FEET
11/28/70
5/14/70
5/27/70
9/24/70
WATER LEVELS
COAL

FIGURE NO. 9
CROSS SECTION C–C'
FROSTBURG SITE NO. 1

EDWARD L. NEWELL, JR. M.C.E.
BRUCE MARTIN, PH.D.
DEC 1970

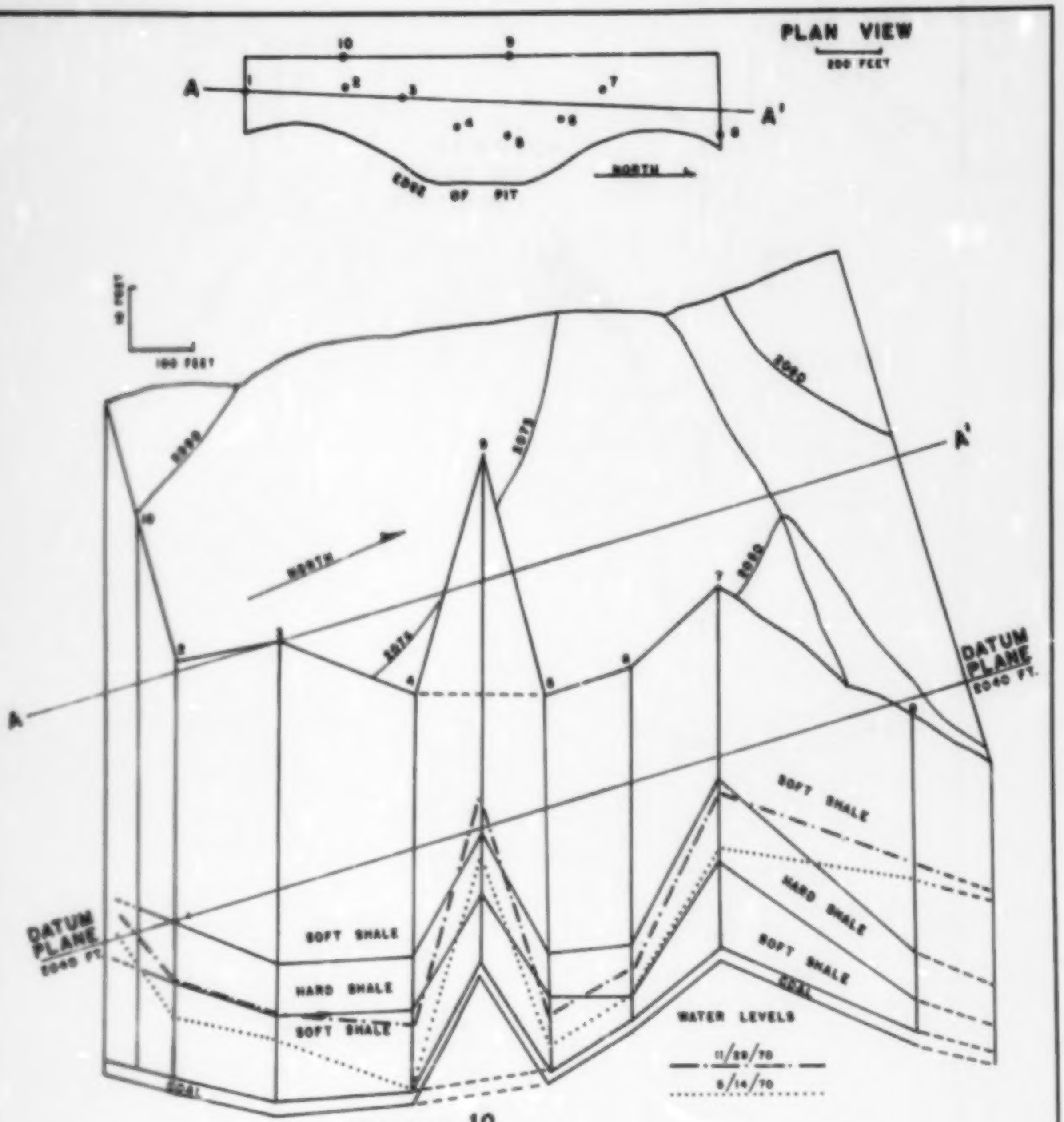
PLAN VIEW
200 FEET
A
A'
1
2
3
4
5
6
7
8
9
10
EDGE OF PIT
NORTH
10 FEET
100 FEET
2090
2075
2080
2075
2080
NORTH
DATUM PLANE 2040 FT.
DATUM PLANE 2040 FT.
SOFT SHALE
HARD SHALE
SOFT SHALE
COAL
SOFT SHALE
HARD SHALE
SOFT SHALE
COAL
WATER LEVELS
11/29/70
5/14/70

FIGURE NO. 10
THREE DIMENSTIONAL FENCE FIGURE
(WEST WALL)
FROSTBURG SITE NO. 1

EDWARD L. NEWELL, JR. M.C.E.
BRUCE D. MARTIN, PH.D.
DEC. 1970

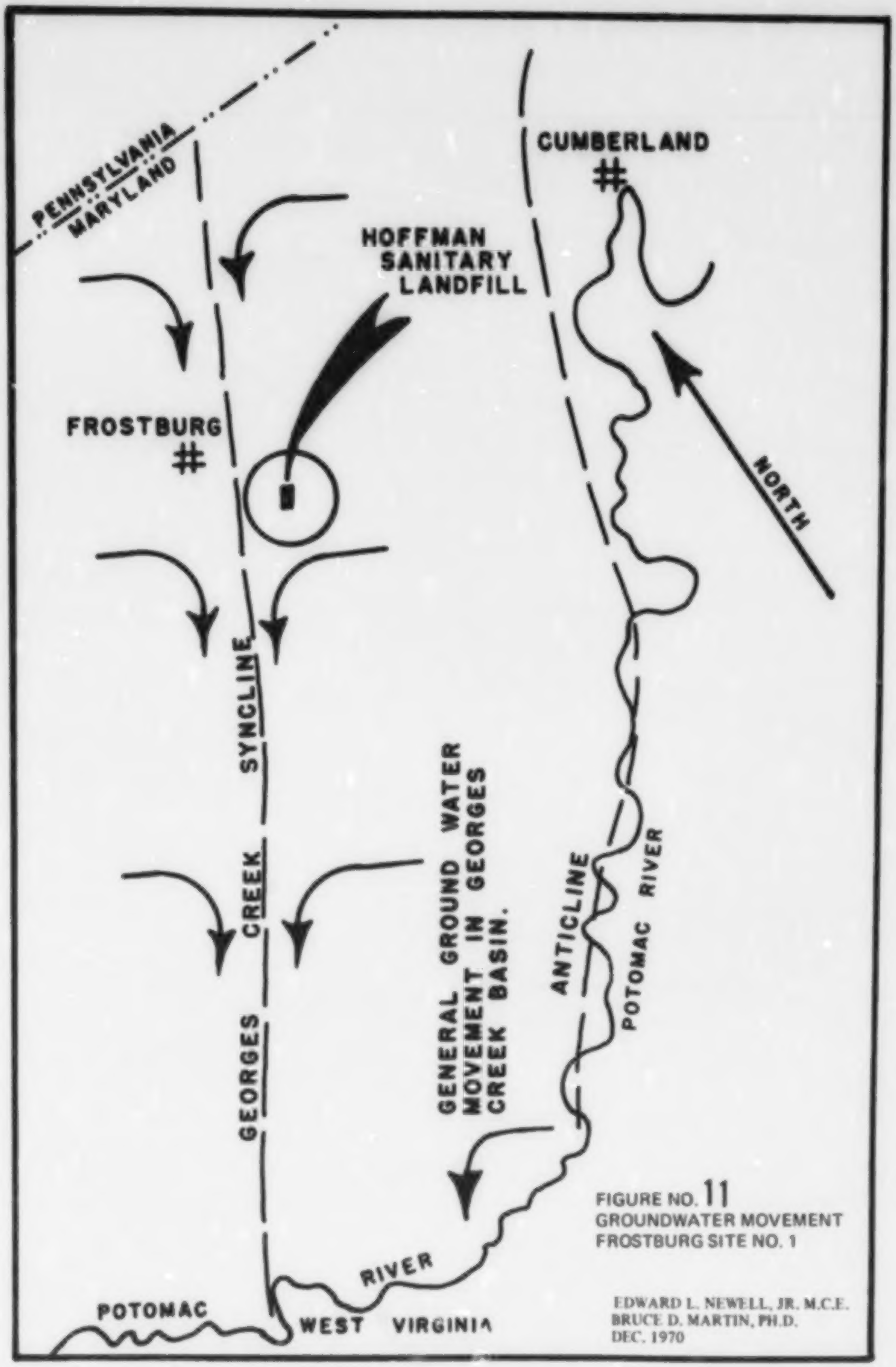
PENNSYLVANIA
MARYLAND
CUMBERLAND
HOFFMAN SANITARY LANDFILL
FROSTBURG
NORTH
GEORGES CREEK SYNCLINE
GENERAL GROUND WATER MOVEMENT IN GEORGES CREEK BASIN.
ANTICLINE
POTOMAC RIVER
POTOMAC
RIVER
WEST VIRGINIA

FIGURE NO. 11
GROUNDWATER MOVEMENT
FROSTBURG SITE NO. 1

EDWARD L. NEWELL, JR. M.C.E.
BRUCE D. MARTIN, PH.D.
DEC. 1970

coal seam (Figures Nos.6 , 8 , and 9). The recognized structural ridge in the coal seam between wells 3 and 7 (Figure No.6), suggests additionally that the direction of water flow may be related to possible fractures developed above the ridge. The dynamiting done to remove the ridge in the center of the pit as previously reported and described in the various progress reports of the Division of Solid Waste Control, may have caused some fracturing but the crevasses probably were present before the dynamiting as indicated by the lack of springs on the west wall (undisturbed strata) in the pit as observed prior to the initiation of the landfill operations.

Water levels in wells 1 through 10 appear not to be directly related to precipitation variations during the period of April to November 1970. However, levels were comparatively high following the late winter and spring rains and levels were low or wells were dry during the late summer.

Water levels rose to the highest elevation on November 28, 1970 following a period of heavy and prolonged precipitation. The monthly average precipitation in the area for the period April through November was:

April	5.26"
May	2.55"
June	3.71"
July	3.95"
August (minimum rainfall period)	1.45"
September	5.20"
October	4.51"
November	3.35"

If the water levels in wells 1 through 10 were directly related to precipication, the levels should have been at a minimum in August and undergone a rising trend in September. As shown in Figures 8 and 9, the wells did not become dry until the period between late September and early November. The rise in water level did not occur until a period of steady and heavy rainfall developed just prior to November 28. These data suggest that water in the beds adjacent to the landfill (as recorded in wells 1 through 10) did not accumulate until a sufficient amount of rain fell to overcome the loss of water by downward leakage and westward flow into the Georges Creek Basin. Thus, this premise accounts for (1) apparent lack of water flow from the adjacent beds into the landfill, and (2) lack of correlation between water levels in wells 1 through 10 and wells A, B, and C.

IV. Landfill Observation Wells A, B, and C:

Within 24 hours after the installation of these observation wells on August 28 and 29, 1970, the leachate level rose three feet in well A. During this same period, wells B and C showed no evidence of leachate accumulation. From August 30 to November 4, 1970, the leachate level rose to six feet from the bottom of the pit in wells A and B. Well C still showed no evidence of leachate. The six feet of leachate remained constant from November 4, 1970 to March 1971.

At the time leachate levels were slowly rising in the landfill wells, the ground water levels in wells 1 through 10 dropped to zero, except in wells 7 and 8. Fluid level variations between the groundwater observation wells (1 through 10) and the landfill wells (A, B and C) did not appear to be related, but additional water level measurements were required for at least another year to enable drawing a conclusion. These data suggested that the fluid levels in the landfill and in rocks adjacent to it were controlled by separate factors and may be one indication that leakage is not a serious occurrence from the landfill into groundwaters of the adjacent rocks. The water samples that have been taken, and will continue to be taken, will be analyzed and the data used to evaluate possible leachate leakage from the landfill.

V. Quantities of Ground Water Available for Dilution:

As the possibility of pollution was always present in this type of environmental situation, it was necessary as a precaution to determine the quantity of available groundwater which could be used for effective dilution. The data shown on Figure No. 12 represented first approximations of water volumes in the ground adjacent to the landfill on May 14 and November 28, 1970. Water volumes were calculated reckoning on the basis of 5% porosity possibly present in the rock fractures, along shale bedding planes, and other voids. From these data, it was possible to determine flow characteristics and dilution factors of possible contaminants.

Area I (Figure No. 12) was that region bounded by the edge of the pit on the east, well No. 8 on the north, well No. 1 on the south, and wells 9 and 10 on the west. Area II was calculated as the region (in vertical section) between wells 1 and 8, and between the upper limits of water levels on May 14, 1970 and the lower limit of the top of the Tyson coal bed. By equating the irregular area to a hypothetical rectangle, the average rock depth or thickness becomes 13.0 feet between the upper and lower limits. Area III was similarly calculated for November 28, 1970, and an

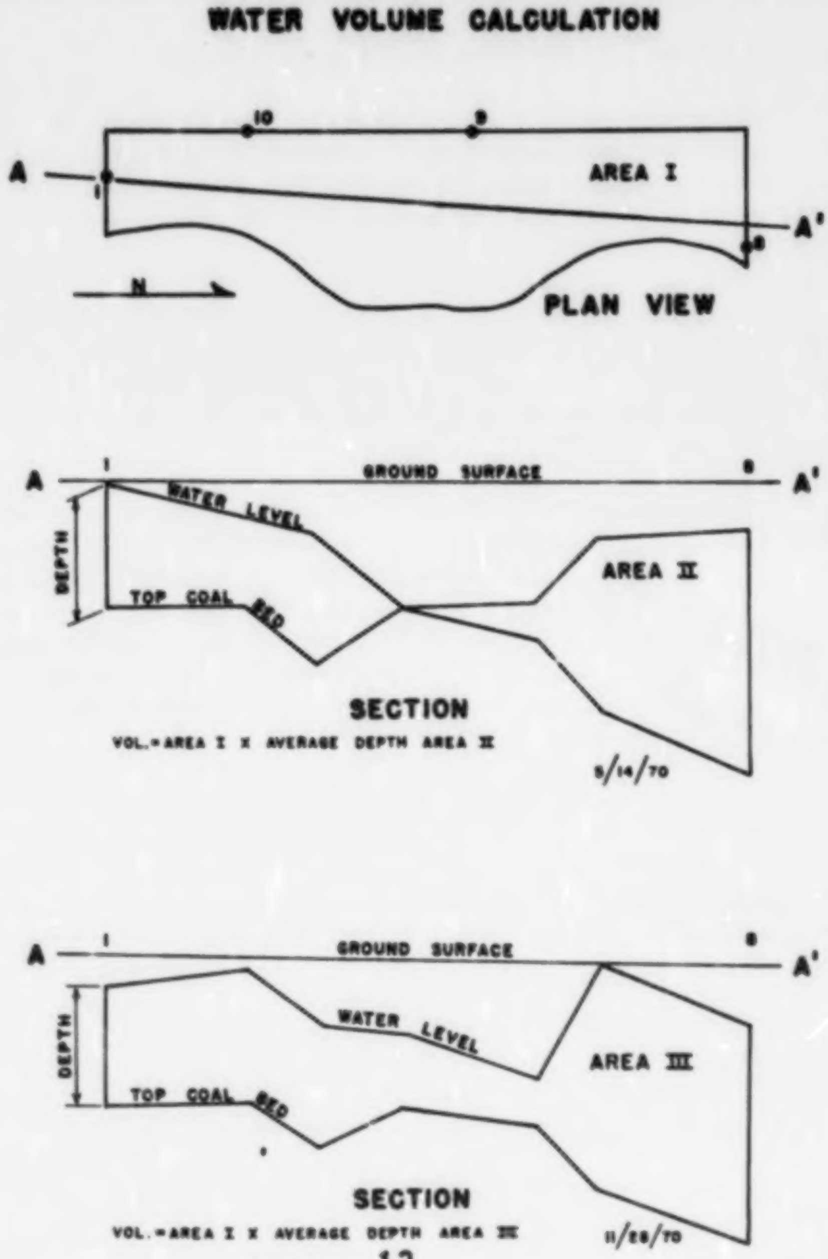
WATER VOLUME CALCULATION
10
9
A
AREA I
1
A'
8
N
PLAN VIEW
A
1
GROUND SURFACE
8
A'
WATER LEVEL
DEPTH
TOP COAL BED
AREA II
SECTION
VOL.=AREA I X AVERAGE DEPTH AREA II
5/14/70
A
1
GROUND SURFACE
8
A'
WATER LEVEL
DEPTH
TOP COAL BED
AREA III
SECTION
VOL.=AREA I X AVERAGE DEPTH AREA III
11/28/70

FIGURE NO. 12
WATER VOLUME CALCULATION
FROSTBURG SITE NO. 1

EDWARD L. NEWELL, JR. M.C.E.
BRUCE D. MARTIN, PH.D.
DEC. 1970

average rock depth or thickness of 15 feet was obtained.

Multiplying the thickness of Area I by Area II results in a rock volume of 5,460,000 cubic feet; assuming 5% fractures or void space, 273,000 cubic feet of porosity (voids) occur. Multiplying this porosity volume by 7.5 gallons of water per cubic foot results in 2,047,500 gallons of water. Again, this is for May 14, 1970.

Multiplying the thickness of Area I by Area III results in a rock volume of 6,300,000 cubic feet; assuming 5% fractures of void space, 315,000 cubic feet of porosity (voids) occur. Multiplying this porosity volume by 7.5 gallons of water per cubic foot results in 2,362,500 gallons of water available on November 28, 1970.

These data suggest at these two given dates that approximately 2,000,000 gallons and 2,300,000 gallons of water were available respectively for dilution purposes. (For additional complicating factors, it must be remembered that all wells except 7 and 8 were dry on November 4, 1970). Theoretically, at the given instant of time on May 14, 1970, if two gallons of contaminant diffused rapidly, it would have been diluted to a concentration of 1 part per million. Similarly, on November 28, 1970 two and three tenths gallons of contaminant would have been diluted to approximately 1 part per million.

These data and assumptions did not consider the diffusion factor or continuous ground water flow as indicated by the surface gradient of the water table, but they suggested a method to determine if a landfill of a given volume of refuse would contribute enough leachate into the ground water system (and if such leachate were dispersed uniformly) to materially affect the ground water quality. This suggested the general equation:

$$c = \frac{1}{v} \quad (k)$$

where c = contamination of ground water in parts/million or other acceptable expressed quantities.

v = volume of water in pores, voids and/or fractures in gallons of water.

k = permeability of beds or ease of flow of water in Darcies.

For a constant quantity of leachate entering the ground water system, various cases are suggested:

(a) As v increases, c will decrease

(b) As v decreases, c will increase

(c) As v remains constant, c will remain constant

Case (c) is impossible in reality, as v is changing constantly; this case will not be considered in the discussion.

For a stated period of study, if water volumes within the pores, fractures, or voids of a given volume of rock or sediments were calculated (Fig. No. 12), and if samples of water were available containing contaminants in parts per million or any other expression of results, the contamination per total water volume could be calculated.

$k_1 = v_1 \cdot c_1$ (contaminant in ppm)

$k_1 = v_2 \cdot c_2$ (new degree of contamination)

$v_1 \; c_1 = v_2 c_2$

As an example, if a water sample were obtained as an average of all samples and was calculated as containing 0.22 ppm Pb, then based on 1,000,000 gallons of water, the following is expressed:

$$\frac{(1,000,000 \text{ gals}) \quad (0.22 \text{ ppm})}{{}^{*}(2,000,000 \text{ gals.})} = c_2$$

$$1/2 \; (0.22 \text{ ppm}) = c_2$$

$$0.11 \text{ ppm} = c_2$$

It is essential from the equation to know also the volume of water which would dilute the leachate and not just the quantity of contaminant. The contaminant calculated from total water volumes (Equation 4; Fig. No. 12), must be a result of analysis over a period of at least a year. When the wells were dry during part of the year, contamination could have been extreme and conversely when water volumes were greater than the 2,000,000 gallons given in the sample, dilution should have lowered the concentration below 0.11 ppm.

---

* Approximate water volume obtained in Fig 12 May 14, 1970

This phase of the study will continue in the field with the obtaining of additional water level data. Tracer injections different from the types planted in the landfill can be placed in wells 1 and 8 to more accurately observe the ground water movement phenomena.

To help establish the velocity of flow in the ground water system, 24 hour recovery rates were determined on February 28, 1970. Using a 3 inch submersible pump rated at 476 gallons/hour, well number 1 was pumped for 20 minutes with no noticeable change from the original water level before pumping. Recovery rates for pumping all wells will be continued at a later date.

VI. Conclusions:

From fluid level data both in the landfill wells and in adjacent ground water observation wells, there was no direct interaction of fluid systems between the two areas. Ground water apparently was flowing both parallel to the lengthwise trench of the landfill and away from it.

Water samples in the observation wells will be analyzed over at least a one year period to note if fluids are flowing from the landfill into the natural ground water system. The dilution studies are most important in the final analysis of the water samples.

SPECIAL STUDIES

Concurrent with the operation of the sanitary landfill demonstration project, a program of special studies was undertaken with the following objectives:

1. Monitoring of domestic ground and surface water sources in the vicinity to determine possible degradation of water quality due to the operation of the Frostburg and Westernport sanitary landfills.

2. Determining the landfill utilization pattern in terms of population served, amount of waste received for disposal, and changes resulting from viable waste management practices.

3. Developing new or modifying existing field sampling methods and laboratory procedures for studying the various physical, chemical, and biological effects of landfill operation. Also, to determine the feasibility of using selected chemical tracers in the landfill for observing the possible migration of pollutants to nearby groundwater test wells.

4. Determining landfill settlement.

5. Determining the type of vegetative cover on the Frostburg landfill that would give optimum growth on reclaimed sections.

6. Studying the effects of specific industrial waste in helping to neutralize the effects of acid mine drainage at the Westernport site.

These objectives are discussed in greater detail in the following presentations.

WATER SAMPLING PROGRAM

* As mentioned previously, a program was conducted during the period 1966 through 1969 to collect water samples from private wells and surface sources to obtain background information and to determine possible changes in the physical and chemical qualities as a result of the Frostburg and Westernport landfill operations. The results of the laboratory examination of these samples showed no significant changes or harmful effects. The findings of these tests are summarized in Table 4.

* In addition, a similar testing program was instituted to monitor the quality of the water in the ten groundwater observation wells at the Frostburg site. The results of the determinations for pH, total residue, volatile residue, chlorides, oxygen demand, total iron, and hardness are shown in Table 5.

* The variety of microrganisms isolated from the samples from the groundwater wells was initially surprising. However, on consideration it was determined that these organisms were not uncommon to the general soli-water environments.

Some organisms were plated out as facultative anaerobes but could not be isolated in pure culture. It is possible that these could be anaerobes functioning as aerobes under the influence of some dissolved oxygen in the groundwater.

Organisms isolated and identified do not exclude the presence of others, but may very well represent those most easily isolated. Slower growing organisms may well have been obliterated by more rapidly growing ones.

The microbiological flora present may only be representative of the season of the year and the conditions at the time of sampling. It is difficult to speculate as to the products of metabolism, that may be representative of certain genera of organisms, which would limit proliferation of other organisms or create toxic conditions for the general flourishing at a given time. A summary of the laboratory findings is included in Table No. 6.

* As a matter of general interest, ambient air temperature, temperatures inside the well casings and liquid levels were recorded for landfill observation wells A, B, and C, and groundwater well No. 1. These data are shown in Table No. 7.

* As described earlier, the landfill wells were fitted with gas sampling devices to permit collection of specimens for determination of methane, CO_2, H_2S, Ammonia, and other gases. The results of the examination of these samples are shown in Table No. 8.

* The possible presences of herbicides and pesticides in leachates collected from the landfill observation wells was investigated by the use of standard chromatographic techniques. However, their presence was not confirmed. It was noted that because of the high concentrations of greases and oils in the samples, along with a high color, it was not possible to prepare these samples properly for the testing procedures. See Table No. 9 for results.

* Tests were carried out for heavy metals on samples of leachates from the landfill observation wells. It was found that mercury, lead, and cadmium were absent and that the concentration of copper, zinc, and nickel, were about the same as those observed in samples from the groundwater wells. See Table No. 10.

* Although boron compounds were used as tracers for determining the movement of leachates from the sanitary landfill to the groundwater observation wells, positive proof of their effectiveness as water movement indicators cannot be unquestionably stated at this time. The absence of boron in the ground water samples seems to verify a lack of sanitary landfill-groundwater interaction since boron compounds were seeded into the landfill observation wells.

There was no evidence in these preliminary findings that was an interchange of pollutants between the Frostburg sanitary landfill and the adjacent groundwater observation wells.

TABLE NO. 4
PRELIMINARY WATER SAMPLING PROGRAM
FROSTBURG SITE NO. 1 & WESTERNPURT SITE NO. 2
RESULTS OF LABORATORY EXAMINATIONS

Date	Source	pH	Nonfiltrable residue	Volatile residue	Nitrite	Nitrate	Dissolved oxygen	Oxygen demand (biochemical)	Phosphate	Filtrable residue	Color	Turbidity	Chloride	Nitrogen	Albuminoid	Ammonia	Total residue	Alkalinity (Ca CO$_3$)	Hardness (Ca CO$_3$)	Iron	Silica	Aluminum	Calcium	Magnesium	Manganese	Carbonate	Sulfate	Fluoride	Carbonate stability	pH	Alkalinity	Copper	Lead	Sodium	ABS (Alkyl benzene sulfonate)
			mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	UNITS	UNITS	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15		16	17	18	19	20	21	22	23	24	25	26	27		28		29	30	31	32
2/20/67	LP-1	4.3	—	—	—	—	—	—	—	122	3	3	4		—	—	120	103	97	0.0	6.0	.02	40	6.4	0.0	20	12	0.1		—	—	0.8	.002	—	—
3/16/67	LP-1	7.0	6.0	—	.008	.7	9.5	.4	.14	106	3	3	4		.04	—	202	128	110	0.1	5.8	.02	47	12	0.0	—	22	0.0		7.7	68	0.9	.001	—	—
3/21/67	LP-1	—	2	—	.001	.30	8.1	.8	.25	270	5	2.7	2.2		—	—	272	182	240	—	9.0	.05	158	82	1.5	—	23	0.1		—	—	0.1	.01	—	—
11/7/67	LP-1	7.8	—	—	—	2.4	—	—	—	—	25	10	3.5		—	—	154	125	106	0.1	—	—	—	—	—	—	—	—		7.8	118	0.3	—	—	—
1/15/68	LP-1	7.9	—	—	—	1.1	—	—	—	—	5	3	3.0		—	—	—	98	93	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/2/68	LP-1	7.9	—	—	—	.06	—	—	—	—	3	3	5.0		—	—	266	189	207	0.0	—	—	—	—	—	—	—	—		—	—	—	—	8.0	—
7/2/68	LP-1	7.6	—	—	—	1.0	—	—	—	—	3	5	7.5		—	—	260	184	192	0.1	—	—	—	—	—	—	—	—		7.6	156	—	—	—	—
10/68	LP-1	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/3/69	LP-1	2.7	2.0	—	—	.24	—	—	.12	—	10	5	273		—	—	244	270	88	0.1	6.8	.076	40	4.5	0.0	—	9.4	0.1		6.7	140	.025	.021	1.5	0.1
4/30/69	LP-1	6.7	—	—	—	.60	—	—	—	—	3	3	9		—	—	224	126	151	0.1	—	—	—	—	—	—	—	—		—	—	—	—	—	—
8/14/69	LP-1	7.8	—	—	—	1.6	—	—	—	—	7	5	3.8		—	—	144	101	95	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/24/69	LP-1	7.4	—	—	—	1.8	—	—	—	—	3	3	4.3		—	—	104	87	85	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/4/70	LP-1	7.5	—	—	—	1.5	—	—	—	—	8	3	17		—	—	256	125	149	0.70	—	—	—	—	—	—	—	—		—	—	—	—	—	—
5/4/70	LP-1	7.1	—	—	—	.06	—	—	—	—	3	3	1.8		—	—	340	231	270	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-1	7.6	—	—	—	3.4	—	—	—	—	3	2	1.0		—	—	150	99	113	0.0	—	—	—	—	—	—	—	0.10		—	—	—	—	2.0	—
2/26/71	LP-1	7.0	—	—	—	.06	—	—	—	—	3	2.5	15		—	—	338	239	246	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
1/15/68	LP-2	6.1	—	—	1.9	—	—	—	—	—	70	30	2.5		—	—	754	33	438	9	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/2/68	LP-2	6.4	—	—	.16	—	—	—	—	—	5	32	3.0		—	—	834	44	401	12	—	—	—	—	—	—	—	—		—	—	—	—	6.5	—
7/8/68	LP-2	6.8	—	—	.04	—	—	—	—	—	3	5	8.5		—	—	920	33	406	0	—	—	—	—	—	—	—	—		—	—	—	—	3.5	—
10/68	LP-2	6.7	—	—	.60	—	—	—	—	—	25	30	11		—	—	866	27	417	.7	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/3/69	LP-2	2.7	1.0	—	.00	—	—	—	.14	—	5	3	200		—	—	740	226	447	7	13	.47	12.4	35	2.6	0	385	.4		7.2	102	0	.005	7.5	0.1
4/30/69	LP-2	6.6	—	—	.30	—	—	—	—	—	3	10	13		—	—	604	29	399	1	—	—	—	—	—	—	—	.30		—	—	—	—	—	—
9/18/69	LP-2	—	—	—	—	0.6	—	—	—	—	90	40	19		—	—	806	31	443	2.0	—	—	—	—	—	—	—	.20		—	—	—	—	6.0	—
10/2/69	LP-2	6.1	—	—	—	0.10	—	—	—	—	8	20	5.0		—	—	766	2.9	429	8.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/2/70	LP-2	5.7	—	—	—	0.60	—	—	—	—	17	20	8.5		—	—	840	9.6	440	7.5	—	—	—	—	—	—	—	.60		—	—	—	—	5.7	—
4/30/70	LP-2	6.5	—	—	—	1.7	—	—	—	—	50	30	14		—	—	970	86	439	5.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-2	6.8	—	—	—	0.10	—	—	—	—	96	53	1.5		—	—	1040	29	569	9.0	—	—	—	—	—	—	—	0.40		—	—	—	—	6.5	—
2/26/71	LP-2	6.2	—	—	—	0.20	—	—	—	—	15	77	15		—	—	732	48	420	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/20/67	LP-3	7.6	—	—	—	.08	—	—		102	70	7	5.5		—	0	96	29	42	1.0	.9	0.0	16	5	4	0.0	38	3		8.0	35	.2	.0081	—	—
3/16/67	LP-3	7.3	22	—	.012	.40	10.0	3.2	.06	94	50	15	5.0		19	0	116	22	26	1.2	3.8	.02	16	5	3	0.0	37	3		8.3	19	0.0	.001	—	—
3/21/67	LP-3	—	26	—	.0005	.08	1.3	3.8	.20	94	45	16	0.5		—	.2	120	23	—	—	3	.15	34	—	3	—	37	3		—	—	< 1	< .01	—	—
4/19/67	LP-3	7.5	17	—	.007	.40	9.4	2.7	.03	122	55	7	5.0		22	.008	126	32	49	1.4	4.4	0.0	17	5.7	.25	0.0	47	2		8.2	45	.05	.005	—	—
11/7/67	LP-3	6.9	—	—	—	.80	—	2.5	—	—	25	30	4.8		—	—	100	38	53	1.4	—	—	—	—	—	—	—	—		8.0	52	.03	—	—	—
1/15/68	LP-3	7.2	—	—	—	1.1	—	—	—	—	70	15	4.5		—	—	104	46	45	1.6	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/2/68	LP-3	7.3	—	—	—	.10	—	—	—	—	30	5	2.0		—	—	118	20	44	.6	—	—	—	—	—	—	—	—		—	—	—	—	4.0	—
7/2/68	LP-3	7.2	—	—	—	.30	—	—	—	—	90	25	7.3		—	—	124	51	38	9.0	—	—	—	—	—	—	—	—		8.2	62	—	—	—	—
10/68	LP-3	7.1	—	—	—	.04	—	—	—	—	30	7	8.0		—	—	108	50	72	.5	—	—	—	—	—	—	—	—		7.9	8.0	—	—	—	—
10/68	LP-3	7.0	—	—	—	0.0	—	—	—	—	25	10	6.5		—	—	116	57	62	.4	—	—	—	—	—	—	—	—		8.1	61	—	—	—	—
2/3/69	LP-3	3.0	14	—	—	0.14	—	—	0.0	—	10	18	176		—	—	178	167	71	.3	7.6	0.14	15	15	.35	0.0	29	0.2		7.5	99	.125	.006	1.0	0.1
4/30/69	LP-3	7.3	—	—	—	0.20	—	—	—	—	40	15	6		—	—	102	30	42	2.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/21/69	LP-3	7.5	—	—	—	0.10	—	—	—	—	35	15	7.5		—	—	90	29	42	0.60	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/70	LP-3	7.0	—	—	—	0.14	—	—	—	—	20	10	11		—	—	98	27	55	0.40	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-3	8.4	—	—	—	0.12	—	—	—	—	45	4.5	1.0		—	—	130	46	62	0.80	—	—	—	—	—	—	—	0.20		—	—	—	—	0.5	—
2/26/71	LP-3	6.5	—	—	—	0.15	—	—	—	—	40	22	15		—	—	150	18	66	0.20	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/69	LP-4	6.4	—	—	—	—	—	—	—	—	60	25	—		—	—	120	21	67	1.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/24/69	LP-4	7.0	—	—	—	—	—	—	—	—	25	10	—		—	—	86	30	41	0.20	—	—	—	—	—	—	—	—		—	—	—	—	—	—
8/24/69	LP-4	7.2	—	—	—	7.2	—	—	—	—	40	12	—		—	—	92	39	53	0.30	—	—	—	—	—	—	—	—		—	—	—	—	—	—
1/13/70	LP-4	7.1	—	—	—	—	—	—	—	—	18	5			—	—	128	29	39	0.20	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/70	LP-4	6.5	—	—	—	0.10	—	—	—	—	10	5	7.1		—	—	104	27	86	2.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-4	7.2	—	—	—	—	—	—	—	—	10	1.5	—		—	—	168	51	79	0.10	—	—	—	—	—	—	—	0.20		—	—	—	—	18	—
2/26/71	LP-4	6.5	—	—	—	0.05	—	—	—	—	5	5.7	20		—	—	174	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
11/7/67	LP-5	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
1/15/68	LP-5	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/2/68	LP-5	3.8	—	—	—	.30	—	—	—	—	10	5	4.5		—	—	124	.19	30	2.0	—	—	—	—	—	—	—	—		—	—	—	—	8.8	—
7/2/68	LP-5	3.3	—	—	—	.30	—	—	—	—	10	30	5.5		—	—	222	.60	45	1.8	—	—	—	—	—	—	—	—		8.0	40	—	—	—	—
0/68	LP-5	3.0	—	—	—	.30	—	—	—	—	45	90	5.0		—	—	862	.106	145	12	—	—	—	—	—	—	—	—		—	—	—	—	—	—
/69	LP-5	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—

TABLE NO. 4
PRELIMINARY WATER SAMPLING PROGRAM
FROSTBURG SITE NO. 1 & WESTERNPORT SITE NO. 2
RESULTS OF LABORATORY EXAMINATIONS

Date	Source	pH	Nonfiltrable residue	Volatile residue	Nitrite	Nitrate	Dissolved oxygen	Oxygen demand (biochemical)	Phosphate	Filtrable residue	Color	Turbidity	Chloride	Nitrogen	Albuminoid	Ammonia	Total residue	Alkalinity (Ca CO$_3$)	Hardness (Ca CO$_3$)	Iron	Silica	Aluminum	Calcium	Magnesium	Manganese	Carbonate	Sulfate	Fluoride	Carbonate stability	pH	Alkalinity	Copper	Lead	Sodium	ABS (Alkyl benzene sulfonate)
			mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	UNITS	UNITS	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15		16	17	18	19	20	21	22	23	24	25	26	27		28		29	30	31	32
2/16/67	LP-6	7.1	11	—	.016	.70	10.6	—	.00	224	30	10	6.0		.002	.004	240	17	106	0.3	6.9	.01	25	22	.11	0.0	105	0.1		7.7	29	0.0	.005	—	—
3/21/67	LP-6	—	4	—	.003	.38	12.6	1.8	.17	304	18	12	8.5		—	—	208	—	134	0.2	5.0	.05	5.4	80	.06	—	53	0.3		—	—	0.1	.01	—	—
11/7/67	LP-6	3.7	—	—	—	.10	—	—	—	—	35	38	—		—	—	1562	94	444	50	—	—	—	—	—	—	—	—		7.2	79	.28	—	—	—
1/15/68	LP-6	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/2/68	LP-6	7.1	—	—	—	1.2	—	—	—	—	18	28	71		—	—	1238	207	160	10	—	—	—	—	—	—	—	—		—	—	—	—	46	—
7/2/68	LP-6	7.9	—	—	—	.50	—	—	—	—	50	198	52		—	—	1146	521	260	12	—	—	—	—	—	—	—	—		7.6	449	—	—	—	—
10/68	LP-6	7.7	—	—	—	.10	—	—	—	—	70	30	82		—	—	702	248	176	10	—	—	—	—	—	—	—	—		6.6	107	—	—	—	—
2/3/69	LP-6	4.7	58	—	—	—	—	—	1.64	—	60	25	307		—	—	3162	210	324	75	26	2.2	284	82	0.0	0.0	337	1.0		6.0	269	.05	.14	186	—
4/30/69	LP-6	5.8	—	—	—	3.0	—	—	—	—	120	100	341		—	—	7058	1975	2310	200	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/24/69	LP-6	7.1	—	—	—	0.3	—	—	—	—	110	300	23		—	—	37616	2303	1513	2250	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/70	LP-6	5.3	—	—	—	3.8	—	—	—	—	400	112	192		—	—	3316	584	0.0	100	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/20/67	LP-7	6.9	—	—	—	.64	—	—	—	278	12	5	10		—	4.0	272	171	204	1.0	7.7	0.0	61	18	0.35	0.0	52	0.3		7.6	162	0.0	.005	—	—
3/16/67	LP-7	6.9	12	—	.012	.44	8.4	.2	.03	336	5	2	7		.036	.100	352	184	212	1.5	5.5	.03	77	21	0.4	0.0	78	0.1		7.4	190	0.02	.004	—	—
3/21/67	LP-7	2	—	—	.0015	.06	1.3	4.2	.17	—	15	7.0	4.0		—	.2	240	—	200	—	9	.05	180	100	0.75	—	44	0.2		—	—	<0.1	<.01	—	—
8/19/67	LP-7	6.8	90	—	.008	0.6	5.4	—	0.0	.70	3	7	5.5		.032	.144	266	158	190	.90	8.0	.03	59	16	—	0.0	34	0.2		7.4	167	0.0	.004	—	—
11/7/67	LP-7	7.0	—	—	—	.08	—	—	—	—	7	7	10		—	—	266	165	205	1.2	—	—	—	—	—	—	—	—		7.4	155	0.0	—	—	—
1/15/68	LP-7	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/2/68	LP-7	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/2/68	LP-7	6.9	—	—	—	.10	—	—	—	—	12	5	9.5		—	—	274	150	190	2.2	—	—	—	—	—	—	—	—		7.5	155	—	—	—	—
10/68	LP-7	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/3/69	LP-7	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/69	LP-7	5.8	—	—	—	3.0	—	—	—	—	120	100	341		—	—	7058	1975	2310	200	—	—	—	—	—	—	—	—		5.5	—	—	—	—	—
2/3/69	LP-8	2.8	0.0	—	—	.16	—	—	.23	—	3	3	309		—	—	564	-177	238	3	7.2	.27	112	18	.65	0.0	61	.3		6.0	119	0.0	0.0	2.5	0.1
4/30/69	LP-8	7.1	—	—	—	.40	—	—	—	—	3	5	7.3		—	—	258	186	202	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/24/69	LP-8	7.4	—	—	—	1.8	—	—	—	—	3	3	4.3		—	—	104	97	85	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/31/69	LP-8	7.2	—	—	—	0.04	—	—	—	—	10	25	9.3		—	—	256	200	227	2.0	—	—	—	—	—	—	—	0.3		—	—	—	—	—	—
4/30/70	LP-8	7.3	—	—	—	0.30	—	—	—	—	15	10	11		—	—	242	194	218	2.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/26/71	LP-8	7.3	—	—	—	0.28	—	—	—	—	15	2.3	11		—	—	256	193	207	1.5	—	—	—	—	—	—	—	—		—	—	—	—	—	—
8/5/68	LP-12	7.3	—	—	—	0.8	—	—	—	—	7	15	4.5		—	—	276	98	153	.30	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/8/68	LP-12	7.3	—	—	—	2.0	—	—	—	—	10	5	5.5		—	—	252	100	120	.10	—	—	—	—	—	—	—	—		7.7	104	—	—	—	—
2/3/69	LP-12	3.1	50	—	—	2.0	—	—	.08	—	5	10	179		—	—	348	-117	176	.10	11	.13	60	12	0.0	0.0	68	0.2		7.3	104	.10	0.0	4.0	<0.1
4/30/69	LP-12	7.2	—	—	—	1.1	—	—	—	—	5	3	6.3		—	—	202	106	165	—	0.0	—	—	—	—	—	—	—		7.5	106	—	—	—	—
8/14/69	LP-12	7.0	—	—	—	—	—	—	—	—	25	25	—		—	—	522	106	174	.50	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/23/69	LP-12	6.7	—	—	—	1.4	—	—	—	—	5	3	5.0		—	—	336	136	224	.70	—	—	—	—	—	—	—	—		—	—	—	—	—	—
1/15/70	LP-12	7.4	—	—	—	—	—	—	—	—	3	3	—		—	—	304	180	183	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/30/70	LP-12	7.2	—	—	—	.06	—	—	—	—	45	30	11		—	—	246	95	167	.4	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-12	7.0	—	—	—	—	—	—	—	—	5	1	—		—	—	368	102	194	0.0	—	—	—	—	—	—	—	0.10		—	—	—	—	8.3	—
10/20/67	LP-13	7.0	—	—	—	.04	—	—	—	—	3	5	3.5		—	—	664	24	422	.40	—	—	—	—	—	—	—	—		7.8	21	0.0	—	—	—
10/3/68	LP-13	3.0	—	—	—	0.0	—	—	—	—	7	20	5.0		—	—	2192	-53	902	14	—	—	—	—	—	—	—	—		7.4	53	—	—	—	—
2/3/69	LP-13	2.6	120	—	—	.10	—	—	1.0	—	30	97	270		—	—	3026	-562	1600	75	101	14	480	115	0.0	0.0	1607	0.5		6.4	140	1.0	.002	14	<0.1
4/30/69	LP-13	2.9	—	—	—	.18	—	—	—	—	7	65	8.0		—	—	3076	-70	1500	25	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/2/70	LP-13	2.9	—	—	—	.04	—	—	—	—	45	300	13		—	—	3016	420	854	110	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-13	6.4	—	—	—	.30	—	—	—	—	520	58	3.5		—	—	1652	552	327	23	—	—	—	—	—	—	—	—		—	—	—	—	—	—
8/14/70	LP-13	3.4	—	—	—	.20	—	—	—	—	120	80	11		—	—	3362	-95	420	800	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/20/67	LP-14	2.9	—	—	—	.10	—	—	—	—	20	65	5.5		—	—	2512	-318	437	120	—	—	—	—	—	—	—	—		7.8	119	0.18	—	—	—
7/8/68	LP-14	3.3	—	—	—	.60	—	—	—	—	12	1000	9.0		—	—	7020	-25	1394	75	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/8/68	LP-14	3.2	—	—	—	.04	—	—	—	—	20	7	6.3		—	—	3030	-140	221	18	—	—	—	—	—	—	—	—		7.7	203	—	—	—	—
2/3/69	LP-14	2.6	2240	—	—	.00	—	—	0.0	—	10	800	20.9		—	—	3144	-757	797	100	1095	9.4	440	123	90	0.0	1847	0.5		6.5	151	0.25	0.36	8.5	.15
4/30/69	LP-14	2.8	—	—	—	.60	—	—	—	—	10	40	6.3		—	—	3320	-160	1602	25	—	—	—	—	—	—	—	—		—	—	—	—	—	—
8/14/69	LP-14	3.2	—	—	—	.32	—	—	—	—	70	800	3.7		—	—	3720	-185	457	140	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/2/69	LP-14	3.2	—	—	—	.10	—	—	—	—	90	30	6.5		—	—	2452	-192	433	75	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/4/70	LP-14	3.5	—	—	—	.10	—	—	—	—	70	800	3.7		—	—	6720	-183	457	140	—	—	—	—	—	—	—	—		—	—	—	—	—	—
7/8/70	LP-14	3.3	—	—	—	.24	—	—	—	—	86	90	1.5		—	—	2782	-90	486	35	—	—	—	—	—	—	—	0.8		—	—	—	—	18.0	—

– NO REPORT

			mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	UNITS	UNITS	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1		mg/1		mg/1	mg/1	mg/1	mg/1
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15		16	17	18	19	20	21	22	23	24	25	26	27		28		29	30	31	32
7/22/68	LP-15	7.2	—	—	—	4.0	—	—	—	—	3	3	8.5		—	—	650	84	310	0.10	—	—	—	—	—	—	—	—		—	—	—	—	—	—
2/3/69	LP-15	3.1	0.0	—	—	.34	—	—	0.0	—	5	3	116		—	—	706	47	482	1.4	35	.32	176	35	.5	0.0	327	0.2		7.3	76	0.0	.001	1.5	<0.1
4/30/69	LP-15	7.0	—	—	—	2.4	—	—	—	—	7	3	7.5		—	—	684	79	369	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
6/4/69	LP-15	6.9	—	—	—	3.2	—	—	—	—	3	3	0.5		—	—	760	102	401	0.0	—	—	—	—	—	—	—	—		—	—	—	—	—	—
10/21/69	LP-15	6.7	—	—	—	2.6	—	—	—	—	3	3	5.8		—	—	770	105	404	0.10	—	—	—	—	—	—	—	—		—	—	—	—	—	—
4/21/70	LP-15	6.6	—	—	—	14	—	—	—	—	10	5	2.1		—	—	330	25	176	0.30	—	—	—	—	—	—	—	—		—	—	—	—	—	—
6/8/70	LP-15	7.2	—	—	—	0.0	—	—	—	—	5	3	2.8		—	—	750	66	310	0.10	—	—	—	—	—	—	—	—		—	—	—	—	—	—

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TABLE NO. 5
GROUND WATER TEST WELLS
FROSTBURG SITE NUMBER 1
RESULTS OF LABORATORY EXAMINATIONS

DATE	TEST WELL NUMBER	LABORATORY NUMBER	DEPTH TO WATER	pH	TOTAL RESIDUE mg/l	VOLATILE RESIDUE mg/l	CHLORIDES mg/l	OXYGEN DEMAND (BIOCHEMICAL) mg/l	TOTAL IRON mg/l	HARDNESS mg/l
17 Jun 71	1	WML 7127		6.8	533	381	10	35.5	30	370
7 July 71	1	WMA 7202	52'	6.2	552	361	23	720.0	26	300
10 Aug 71	1	WMB 7209	53'	6.4	438	153	10		26	35
15 Sep 71	1	WMC 7214	52'	6.4	397	104	26	4.0	14	200
14 Oct 71	1	WMD 7208	54'	7.0	299	126		4.2	10.5	200
17 Jun 71	2	WML 7127		5.6	218	149	11	9.6	6	220
7 Jul 71	2	WMA 7202	53'	5.4	372	285	10	7.8	2.8	175
10 Aug 71	2	WMB 7209	56'	5.7	561	89	12		7.1	195
15 Sep 71	2	WMC 7214	55'	6.0	298	69	12	5.0	.75	225
14 Oct 71	2	WMD 7208	53'	6.4	239	94		5.4	1.5	250
17 Jun 71	3	WML 7127		5.3	357	276	11	4.8	18	60
7 Jul 71	3	WMA 7202	64'	5.2	272	200	13	5.4	0.6	110
10 Aug 71	3	WMB 7209	66'	5.7	416	73	14		6.1	125
15 Sep 71	3	WMC 7214	67'	6.0	2184	51	10	2	1.5	180
14 Oct 71	3	WMD 7208	66'	6.6	292	109		725	1.5	225
17 Jun 71	4	WML 7127	Dry							
7 Jul 71	4	WMA 7202	Dry							
10 Aug 71	4	WMB 7209	Dry							
15 Sep 71	4	WMC 7214	Dry							
14 Oct 71	4	WMD 7208	Dry							
17 Jun 71	5	WML 7127		5.8	827	71	5	11.4	26	100
7 Jul 71	5	WMA 7202	36'	5.6	412	348	10	6.6	9	150
10 Aug 71	5	WMB 7209	45'	6.0	661	83	12		31.5	170
15 Sep 71	5	WMC 7214	52'	6.1	337	65	8	3.0	11.5	150
14 Oct 71	5	WMD 7208	54'	6.8	1620	167		2.4	58.5	125
17 Jun 71	6	WML 7127		5.9	588	507	9	4.2	13.0	50
7 Jul 71	6	WMA 7202	42'	5.7	150	106	7	3.9	0.7	70
10 Aug 71	6	WMB 7210	45'	6.1	532	60	18		0.0	95
15 Sep 71	6	WMC 7213	48'	6.0	260	21	8	1	7.5	150
14 Oct 71	6	WMD 7209	53'	6.8	486	81	0	2.4	12	140
17 Jun 71	7	WML 7127		6.1	665	552	8	4.2	200	75
7 Jul 71	7	WMA 7202	21'	5.6	704	600	8	5.4	190	110
10 Aug 71	7	WMB 7210	28'	6.1	2220	232	10		140	60
15 Sep 71	7	WMC 7213	33'	6.1	386	30	10	3	180	100
14 Oct 71	7	WMD 7209	31'	6.9	1273	1143		2.4	320	130
17 Jun 71	8	WML 7127		5.2	242	196	8	1.2	16	50
7 Jul 71	8	WMA 7202	33'	5.2	215	171	8	3.9	2.1	75
10 Aug 71	8	WMB 7210	35'	5.9	806	49	11		54	75
15 Sep 71	8	WMC 7213	38'	6.1	176	31	10	2	9	170
14 Oct 71	8	WMD 7209	37'	6.5	964	889		2.4	16.5	75
17 Jun 71	9	WML 7127		4.7	717	629	8	4.2	16	40
7 Jul 71	9	WMA 7202	67'	4.9	241	180	6	4.8	1.3	25
10 Aug 71	9	WMB 7210	62'	5.1	786	57	11		24	55
15 Sep 71	9	WMC 7213	68'	5.7	351	35	10	3	11.5	100
14 Oct 71	9	WMD 7209	70'	6.0	356	226		3	6.5	130
17 Jun 71	10	WML 7127		6.1	1497	1315	7	13.8	12.0	220
7 Jul 71	10	WMA 7202	67'	6.3	447	349	8	4.8	1.4	145
10 Aug 71	10	WMB 7210	68'	6.6	399	62	12		5.9	160
15 Sep 71	10	WMC 7213	70'	6.4	347	77	8	3	4.5	175
14 Oct 71	10	WMD 7209	71'	6.7	462	262		3	5	200

TABLE NO. 6
MICROBIOLOGICAL STUDIES
FROSTBURG SITE NO. 1
MARCH 10, 1971

LABORATORY PROCEDURE	GROUNDWATER OBSERVATION WELL NO. 3	LANDFILL OBSERVATION WELL A
COUNTS		
Aerobic Plate Count	56,000/ml	8,000/ml
Aerobic Spore Count	3,100/ml	3,500/ml
Facultative Anaerobic and Aerobic Spore Count	2,800/ml	480/ml
MPN - Total Coliforms	150/100 ml	93/100 ml
MPN - Fecal Coliforms	0/100 ml	0/100 ml
Fungus Count	850/ml	320/ml
ISOLATIONS		
Fungi	Pencicillium Mucor Rhizopus Aspergillus niger	Mucor Actinomycetes
Aerobic Spore Formers	Bacillus megaterium Bacillus cereus Mycoides (various)	Bacillus subtilis Bacillus cereus Mycoides (various)
Other Aerobic Organisms (Gram Negative)	Enterobacter aerogenes Enterobacter cloacal Alcaligenes faecalis	Absent
Anaerobes	Absent	Clostridium tertium Clostridium sporogenes

TABLE NO. 7

TEMPERATURE AND LEACHATE LEVEL DATA

OBSERVATION WELLS

FROSTBURG SITE NO. 1

Date	Well Identification	Ambient Air Temperature	Temperature in Well Casing (30' Below Surface)	Leachate Depth (feet)
Aug 30, 1970	Landfill Well A	-	-	3.0
Nov 4, 1970	do.	36°F	65°F	4.0
Nov 28, 1970	do.	40°F	60°F	-
Dec 4, 1970	do.	39°F	57°F	1.0
Jan 6, 1971	do.	10°F	55°F	-
Feb 8, 1971	do.	26°F	57°F	-
Aug 18, 1971	do.	-	-	dry
Aug 30, 1970	Landfill Well B	-	-	dry
Nov 4, 1970	do.	36°F	68°F	8.0
Nov 28, 1970	do.	40°F	63°F	-
Dec 4, 1970	do.	39°F	61°F	6.4
Jan 6, 1970	do.	10°F	59°F	-
Feb 8, 1970	do.	26°F	59°F	-
Aug 18, 1971	do.	-	-	1.0
Aug 30, 1970	Landfill Well C	-	-	dry
Nov 4, 1970	do.	36°F	59°F	dry
Nov 28, 1970	do.	40°F	52°F	-
Dec 4, 1970	do.	39°F	46°F	2.3
Jan 6, 1970	do.	10°F	43°F	-
Feb 8, 1970	do.	26°F	44°F	-
Aug 18, 1971	do.	-	-	dry
Aug 30, 1970	Groundwater Well-1	-	-	-
Nov 4, 1970	do.	36°F	51°F*	-
Nov 28, 1970	do.	40°F	52°F*	-
Dec 4, 1970	do.	-	-	-
Jan 6, 1970	do.	-	-	-
Feb 8, 1970	do.	-	-	-
Aug 18, 1971	do.	-	-	-

* Temperature was measured 20 feet below surface instead of 30 feet.

TABLE NUMBER 8
FROSTBURG SITE NUMBER 1
RESULTS OF LABORATORY EXAMINATIONS
GAS SAMPLES FROM OBSERVATION WELLS

DATE	SOURCE	METHANE (percent)	CARBON DIOXIDE (percent)	HYDROGEN SULFIDE (percent)	AMMONIA (percent)	OTHER (percent)
5 Oct 71	Observation Well A	53%	27%	Not Detected	Not Detected	Not Detected
12Oct 71	"	48%	28%	Not Detected	Not Detected	Not Detected
19 Oct 71	"	55%	31%	"	"	"
27 Oct 71	"	55%	28%	"	"	"
2 Nov 71	"	56%	27%	"	"	"
9 Nov 71	"	52%	27%	"	"	"
16 Nov 71	"	56%	24%	"	"	"
22 Nov 71	"	49%	26%	"	"	"
7 Dec 71	"	67%	28%	"	"	"
12 Jan 72	"	60%	28%	"	"	"
2 Feb 72	"	59%	24%	"	"	O_2 & N_2 Detected
18 Apr 72	"	56%	31%	"	"	O_2 & N_2 Detected
5 Oct 71	Observation Well B	56%	31%	Not Detected	Not Detected	Not Detected
12 Oct 71	"	58%	32%	"	"	"
19 Oct 71	"	48%	21%	"	"	"
27 Oct 71	"	57%	32%	"	"	"
2 Nov 71	"	43%	32%	"	"	"
9 Nov 71	"	58%	28%	"	"	"
16 Nov 71	"	56%	32%	"	"	"
22 Nov 71	"	64%	36%	"	"	"
7 Dec 71	"	61%	23%	"	"	"
12 Jan 72	"	62%	27%	"	"	"
2 Feb 72	"	47%	21%	"	"	O_2 & N_2 Detected
18 Apr 72	"	53%	30%	"	"	O_2 & N_2 Detected
5 Oct 71	Observation Well C	58%	30%	Not Detected	Not Detected	Not Detected
12 Oct 71	"	41%	22%	"	"	"
19 Oct 71	"	65%	29%	"	"	"
27 Oct 71	"	59%	31%	"	"	"
2 Nov 71	"	47%	32%	"	"	"
9 Nov 71	"	26%	15%	"	"	"
16 Nov 71	"	56%	30%	"	"	"
22 Nov 71	"	59%	31%	"	"	"
7 Dec 71	"	64%	29%	"	"	"
12 Jan 72	"	64%	28%	"	"	"
2 Feb 72	"	60%	25%	"	"	O_2 & N_2 Detected
18 Apr 72	"	57%	30%	"	"	O_2 & N_2 Detected

TABLE NO. 9

RESULTS OF LABORATORY EXAMINATION OF PESTICIDE AND HERBICIDE SAMPLES

OBSERVATION WELLS
FROSTBURG SITE NO. 1

WELL IDENTIFICATION	PESTICIDES Parts per billion (ppb)	HERBICIDE
GROUNDWATER WELL NO. 1 (1969 - 1971)	SULFUR – 3.3 p.p.b. (CTLC) DDT – 0.5 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 2 (1969 - 1971)	SULFUR – 0.27 p.p.b. (CTLC) DDT – 0.41 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 3 (1969 - 1971)	SULFUR – 1.2 p.p.b. (CTLC) DDT – 0.5 p.p.b. (NCTLC) DDD – 0.1 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 4 (1969 - 1971)	SULFUR – 1.0 p.p.b. (CTLC) DDT – 0.34 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 5 (1969 - 1971)	SULFUR – 0.6 p.p.b. (CTLC) Peak rf value – 2.6 (unidentified)	NEGATIVE
GROUNDWATER WELL NO. 6 (1969 - 1971)	SULFUR – 3.3 p.p.b. (CTLC) Peak rf value – 2.8 (unidentified)	NEGATIVE
GROUNDWATER WELL NO. 7 (1969 - 1971)	SULFUR – 0.08 p.p.b. (CTLC) DDT – 0.2 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 8 (1969 - 1971)	SULFUR – 0.08 p.p.b. (CTLC) DDT – 0.2 p.p.b. (NCTLC)	NEGATIVE
GROUNDWATER WELL NO. 9 (1969 - 1971)	SULFUR – 0.36 p.p.b. (CTLC) Peak matched that of Atrazine – 0.32 p.p.b. DDT – 0.24 p.p.b. N/C Either DDT or Atrazine by TLC	NEGATIVE
GROUNDWATER WELL NO. 10 (1969 - 1971)	SULFUR – 0.2 p.p.b. (CTLC) Peak matched that of Atrazine 1.1 p.p.b. DDT – 0.32 p.p.b. – N/C DDT or Atrazine by TLC	NEGATIVE
LANDFILL OBSERVATION WELL A (Sampled October 15, 1970)	NEGATIVE	NEGATIVE

C – Confirmed by thin Layer Chromatography
C – Not confirmed by thin Layer Chromatography

TABLE NO. 10
SUMMARY OF THE RESULTS OF THE CHEMICAL EXAMINATIONS OF WATER SAMPLES FROM THE GROUND WATER TEST WELLS FROSTBURG SITE NO. 1

*SUBSTANCE mg/l	GROUNDWATER TEST WELLS AT FROSTBURG										DISCUSSION OF LABORATORY RESULTS
	1	2	3	4	5	6	7	8	9	10	
Lead	.168	.467	.116	.190	.182	.214	.033	.080	.390	.040	In only two instances, wells 7 & 10, did the lead concentration fall within PHS standard of 0.05 mg/l
Cadmium	.003	.004	.004	.005	.009	.007	.003	.007	.009	.006	In all cases, the concentration of cadmium remained below the PHS standard of 0.01 mg/l
Copper	.021	.022	.022	.020	.019	.017	.023	.012	.024	.012	The concentrations of copper, in all test wells, were well below the PHS standard of 1.0 mg/l
Mercury Chromium Boron Phenol	--	--	--	--	--	--	--	--	--	--	ABSENT
Zinc	.043	.036	.023	.049	.043	.008	.030	.212	.040	.044	Concentrations of Zinc were well below the PHS standard of 5 mg/l
Nickel	.006	.000	.000	.009	.006	.004	.008	.000	.005	.006	The concentrations of Nickel in all wells were minimal but PHS standards are not available for comparison
Chlorides	1.20	0.34	3.10	3.70	1.10	1.10	1.70	0.80	0.60	0.60	The water in the test was practically free of chlorides. Total solids were quite high in all wells and in all but two instances exceeded the PHS standard of 500 mg/l
Suspended Residue	1246	265	476	437	5068	1295	3245	72	808	730	
Total Residue	1509	438	677	581	5320	1464	3988	185	1025	843	

*All substances with the exception of chlorides, suspended residue and total residue, are reported as the result of one sample.

QUANTITIES OF WASTES RECEIVED FOR DISPOSAL AT THE FROSTBURG & WESTERNPORT FACILITIES

Figures Nos. 13 and 14 show the quantities of wastes received for disposal at the Frostburg and Westernport sites along with estimates of populations served and counts of the number of the vehicles making deliveries.

As may be noted in Figure No. 13, the quantity of refuse rose sharply when the City and Cumberland began to use the Frostburg facility in June, 1968. Peak loading occured from about the middle of 1970 through June, 1971 and then the operation started tapering off to its final closing. At Westernport, a significant rise occured in March, 1969 when industrial wastes began to be received for disposal. Prior to this time, the major generaters of industrial wastes operated their own disposal sites.

From a review of the incomplete waste generation data available, it would appear that the quantity of refuse received for disposal at both places rose from about 50,000 tons per year in 1969 to about 92,000 tons during 1970 which represented a daily per capita production of 3.4 pounds and 5.2 pounds, respectively. It is surmised that the increased quantities of waste resulted from the elimination of illegal dumping areas, provision of an intermediate receptacle for use of householders hauling their own refuse, enforcement of air quality regulations, andthe increased industrial use of the sanitary landfills as a result of closing privately operated disposal facilities.

The population served by the Westernport facility remained fairly constant or at an estimated 15,000 persons during the period of operation. The population served by Frostburg reached an estimated 70,000 persons at the peak of the operation.

As may be noted also, the numbers of vehicles using the sites show an up-and-down pattern. This is attributed to the changes in collection and transportation practices. At the inception of the Demonstration Project, there were approximately eight standard compactor trucks in operation in Allegany County. Other collection vehicles consisted of dump, pick-up, stake, and panel trucks; privately owned automobiles; and small car-drawn trailers. A gradual evolution took place in improvement of the quality of collection practices and in the increased capacity of collection equipment. At the present time some 22 compactor trucks with capacities of from 18 to 23 cubic yards are in service. Other significant developments in collection practices by industries and commercial haulers were the procurement and/or use of:

1. 6-front-end loader container trucks
2. 447-front end loader containers of from 2 to 8 cubic yards capacity
3. 6-roll-off container trucks
4. 28-roll-off containers of from 32 to 45 cubic yards capacity
5. 10-compactor stations (Additional stations are being planned and will be placed into operation in the near future).

FIGURE NO. 13
ESTIMATED POPULATION SERVED, TONS OF REFUSE
PER MONTH, AND VEHICLE COUNT
FROSTBURG SITE NUMBER 1

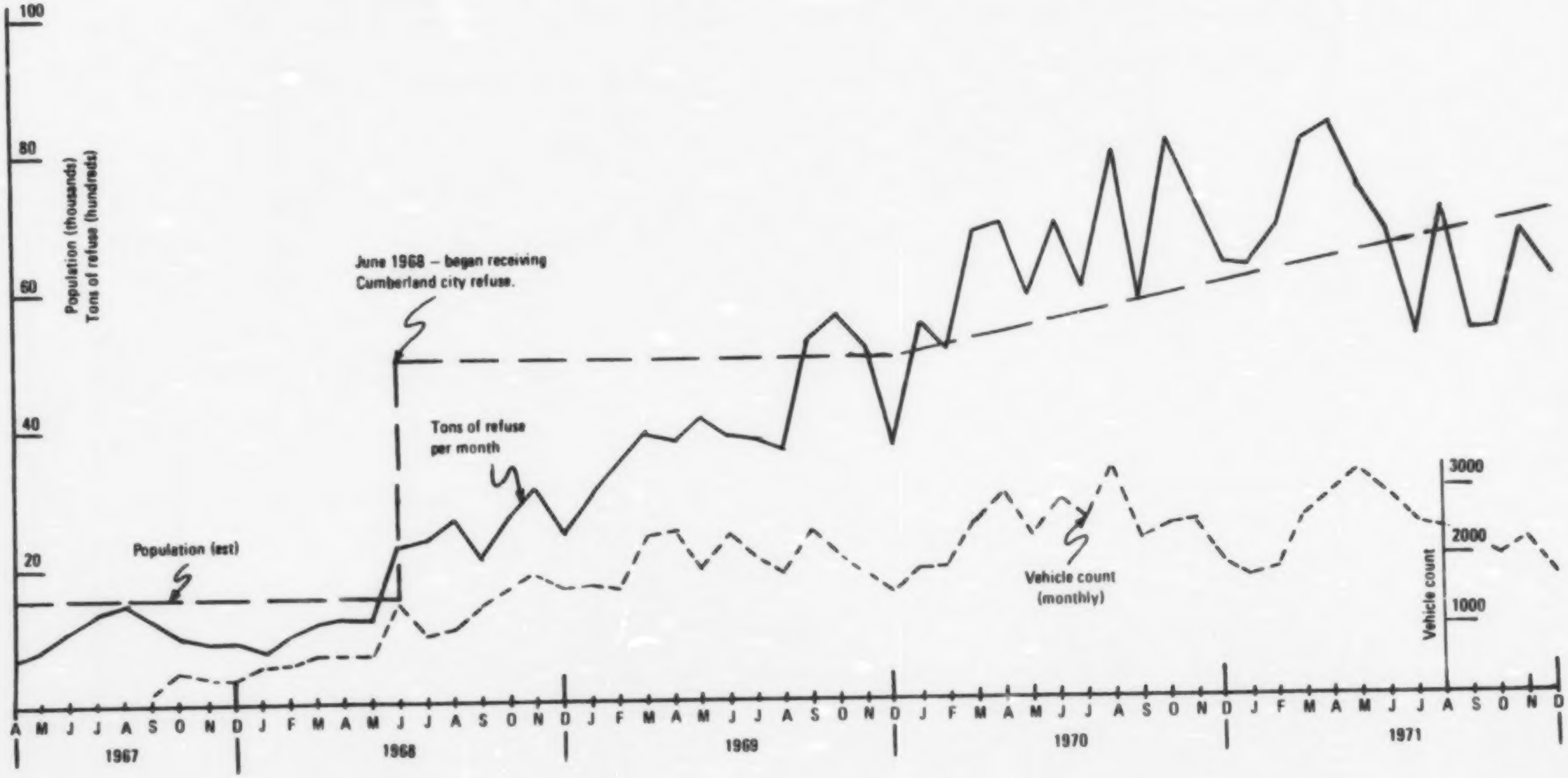
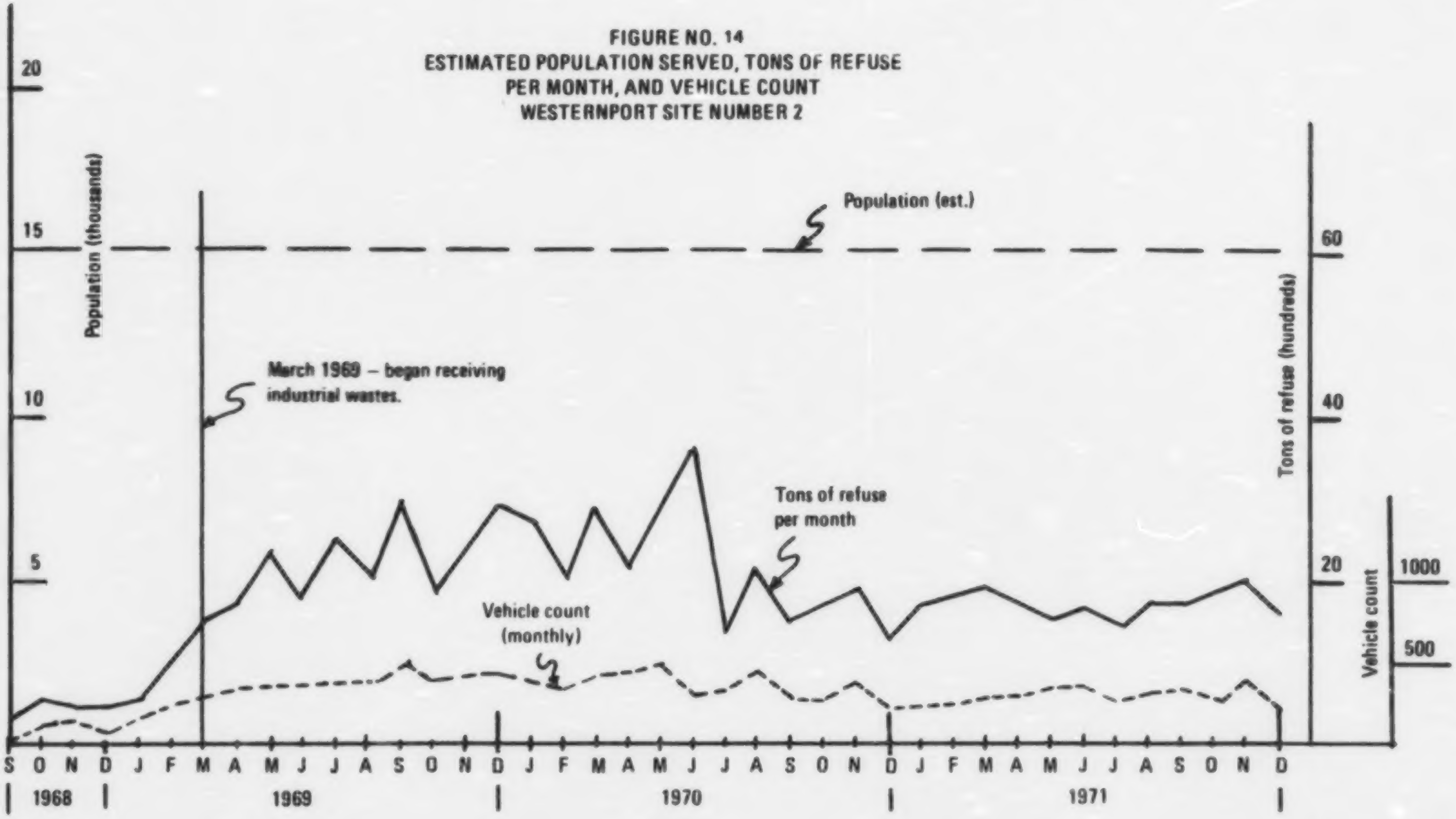


FIGURE NO. 14
ESTIMATED POPULATION SERVED, TONS OF REFUSE
PER MONTH, AND VEHICLE COUNT
WESTERNPORT SITE NUMBER 2



FIELD SAMPLING PROCEDURES AND EQUIPMENT

GROUNDWATER AND LEACHATE OBSERVATION WELLS

FROSTBURG SITE NO. 1

During the first three years of the Demonstration Project, a program was undertaken to sample, at regular intervals, private wells and sources of surface water to determine possible adverse effects on water quality as a result of the operation of the Frostburg sanitary landfill. This initial program was not based on extensive geohydrologic studies as were the fourth and fifth year programs, but was limited to samples collected from existing sources. Refer to Map No. 5 for locations of sampling points.

As mentioned previously, ten groundwater observation wells were installed adjacent to Frostburg Site No. 1 to determine more directly the effects of a sanitary landfill operation on the quality of the groundwater. In addition, three landfill observation wells were installed within the landfill itself for use in leachate, gas, and microbiological studies. To ensure uniformity in sampling operations, the following procedures were established.

GROUNDWATER OBSERVATION WELLS (1 through 10)

Measurements

Prior to collection of samples, the following measurements were made:

1) The water level in each groundwater well was measured and recorded by means of a water level indicator (Soiltest Model 760A)*
2) The ambient air temperature and the air temperatures within the well casings were measured and recorded (Yellow Springs Model 42SF, Telethermometer)
3) The pH of the groundwater in each well was determined and recorded (Fisher Model 120 pH Meter)*

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* Mention of commercial products does not imply indorsement

Specimen Containers

1) Metals - Samples for metals determinations were collected in one-liter plastic jugs containing 0.5 millimeters of concentrated nitric acid to keep the metals in solution.
2) Bacteriologic - Samples for bacteriologic examinations were collected in sterile 100 ml bottles and kept under refrigeration until examined in the laboratory.
3) Pesticides and Herbicides - Pesticides and herbicide samples were collected in calibrated, one gallon jugs previously rinsed with hexane.

Sampling

1) Volume groundwater samples - These were collected in containers which were filled by means of a motor-driven submersible pump lowered into the well casing. The pump was equipped with a one-inch diameter sampling hose, an extension line to a 110-volt AC generator mounted on the engine of a pick-up truck, and a specially designed drop-proof adaptor plate mounted on the top of the pump and attached to a safety cable.
2) Small Samples - These were collected by means of a Teflon-coated cylindrical container which was weighted to over come the water's buoyancy when lowered into a well to draw a specimen.
3) Cross Contamination - To prevent possible cross contamination from well to well following sampling, the foot value was removed and the water in the pump and sampling hose was allowed to drain back into the well as the assembly was being lifted out. The pump assembly was then thoroughly flushed with water from the Frostburg municipal system which was tested for background.

LANDFILL OBSERVATION WELLS (A, B, & C)

Measurements

Prior to collection of samples, the following measurements were made:

1) The water level in each landfill well was measured and recorded.
2) The ambient air temperature and temperature of the gases inside the well casings were measured and recorded.
3) The pH of the leachate in each well was determined and recorded.

Specimen Containers

1) Metals - Samples were collected in the same type of containers as ground-water samples except that concentrated nitric acid was not added.
2) Bacteriologic - Bacteriologic samples were collected in the same type of containers used for groundwater specimens.
3) Pesticides and herbicides - The same type of containers were used as for the groundwater specimens.

Sampling Device

Since the landfill wells contain an appreciable amount of oils and greases which could foul the sampling pump, and since there is only a small volume of liquid in them in comparison to the groundwater wells, all samples were manually collected by means of the Teflon coated container.

GASES

Specimen Containers

Gases were collected in sampling tubes (Fisher Model 210) equipped with entry and exit stop-cocks as well as a rubber membrane covered sampling port for insertion of the needle of a hypodermic syringe in the laboratory collection of gas samples for chromatography work.

Sampling:

Gas samples were collected by removing the screw caps from the one-half inch pipe nipple on the landfill well seal. A piece of plastic tubing was then attached to the pipe nipple and connected to the gas sampling tube. The exit stop-cock of the sampling tube was in turn connected to a vacuum pump by means of plastic tubing.

Collection of gas samples was as follows:

1) Both the inlet and outlet stop-cocks were opened, the vacuum pump was started, and gas flowing through the system was exhausted to the atmosphere.

2) After approximately four liters of gas had been flushed through the system, the stop cocks were closed trapping a sample of the gas in the collection tube. The vacuum pump was stopped immediately.

3) The sample tube of gas was then labeled, packed, and delivered to the laboratory for examination.

Measurements

After collection of the gas sample, the ambient temperature and temperature inside the well casings were measured and recorded. A one-liter sample of leachate was then collected for determination of pH.

LABORATORY TEST METHODS AND PROCEDURES

EXAMINATION OF SAMPLES FROM OBSERVATION WELLS

FROSTBURG SITE NUMBER 1

Groundwater Observation Wells (1 through 10)

Identification of components contributing to the nature of groundwater were limited to:

1. Those chemicals or components which had immediate deleterious effects on groundwater consumers including lead, mercury, cadmium, copper, zinc, nickel, hexavalent chromium, chlorinated hydrocarbon pesticides, and chlorophenoxy herbicides.
2. Traces of boron (sodium metaborate) and chlorides (lithium and sodium) which had been seeded into the landfill and utilized to detect movement of landfill leachates into the groundwater wells system.

Landfill Observation Wells (A, B, and C)

Basic laboratory tests conducted on samples collected from the landfill observation wells were identical to those for the groundwater wells. In addition, tests were made for those chemicals or gases which indicated microbiological activities resulting in nitrates, nitrites and ammonia; other decomposition by-products as methane, hydrogen sulfide, and carbon dioxide; and products such as oils, greases, and phenols.

Standard Methods were used as much as possible for the laboratory examination of samples. However, since some of the tests conducted in the fourth and fifth years were not normally included in a sanitary chemistry analysis, specific testing was sought on a contractual basis utilizing the expertise and sophisticated equipment of private laboratory consulting firms.

The following is a summary of the analytical methods used:

Heavy Metals

1. Mercury was determined by flameless atomic absorption using the Jarrell-Ash Accessory on the Perkin-Elmer Model 403 atomic absorption technique spectrophotometer. The unit was also equipped with the deuterium background corrector and a Model 165 Recorder.

2. Other heavy metals were determined as follows:
   a. The pH of the sample was adjusted.
   b. The metals were chelated with ammonium pyrrolidine dithiocarbamate (APDC).
   c. The chelated metals were then extracted into methyl isobutyl ketone (MIBK).
   d. The concentration of the metals was then measured on a Perkin-Elmer Model 403 atomic absorption spectrophotometer.

3. Detection Limits (parts per billion)

Mercury	1 ppb	Zinc	5ppb
Lead	20 ppb	Copper	10 ppb
Cadmium	5 ppb	Nickel	20 ppb

Pesticide and Herbicide Analysis

Laboratory tests were performed by the Pesticide Laboratory of the Maryland Department of Health and Mental Hygiene. The following methods were used:

1. Pesticides
   a. All jugs were pre-rinsed with hexane before samples were collected in the field.

   b. Water was delivered to the laboratory in one gallon jugs containing 3 1/2 liters of sample.

   c. 150 ml of hexane was added to the sample.

   d. The sample was stirred with a Teflon coated magnetic stirring bar on a Stir-Jack for 50 minutes.

   e. Water was siphoned off using a wide-mouth 5 ml pipette.

   f. A separatory funnel was rinsed with hexane and the sample was added. Water was drawn off to the hexane layer.

g. Hexane was put into a beaker containing sodium sulfate (Na_2SO_4) to remove moisture.

h. The hexane was evaporated to 3.5 ml or a little less and put into a glass stoppered ampoule. Final sample for chromatography was 3.5 ml.

2. Herbicides

   a. Extraction from water
      - (1) Water samples were delivered to the laboratory in one gallon jugs of the type used for pesticides.
      - (2) The water was acidified to a pH of 2.
      - (3) The sample was extracted in the same way as the pesticides but using 100 ml of ethyl ether and 50 ml of petroleum ether instead of hexane.
      - (4) The water layer was siphoned off in the same way as the pesticides samples were prepared.
      - (5) The ether layer was put through a short Na_2SO_4 column into a Kuderna-Danish Flask.
      - (6) The ether was concentrated to about 5 ml on a steam bath.
      - (7) The concentrate was transferred to a 15 ml centrifuge tube and taken near to dryness with a dry air jet.

b. Esterification of Acids (methylation)
   - (1) 250 microliters of BF_3-methanol were added to the sample.
   - (2) The sample was put on a steam bath for two minutes.
   - (3) Contents were washed into a 125 ml separatory funnel with water. (20 ml washed with petroleum ether)
   - (4) The centrifuge tube was rinsed with 30 ml of petroleum ether which was added to the water in the separatory funnel.
   - (5) The separatory funnel was shaken vigorously and then the mixture allowed to separate.
   - (6) The ether layer was drained through Na_2SO_4 into a Kuderna-Danish Flask.
   - (7) The column was washed with ether to remove all herbicides.
   - (8) The K-D Flask was placed on a steam bath and the ether was concentrated to about 3.5 ml.

c. Samples were injected into the chromatograph.

Source: Analysis of Pesticide Residues,
Volume I U.S. Department of
Health, Education, and Welfare
Public Health Service

Extraction: Modification of
Section III A. 1
(1)
Esterification: Section IV,
B, 1, b(1)

Pesticides and Herbicides (Analytical Apparatus)

Chromatographic Operating Parameters and Column Packings

1. Barber-Colman, Model 5000 for organo-phosphates

   Sample - Organic solvent extract of water

   Size injected - usually 5 ul (5 microliters)

   Chart movement - 0.33 inches/minute

   Detector - Thermionic

   Column packing - DC 200 - Anakrom ABS, 100/110 mesh

   Column length - 6 feet

   Outside diameter - 1/4 inch

   Type - Glass

   Sensitivity range - 10

   Attenuator setting - 2

   Recorder response range - One millivolt

   Temperature of injector - 210°C

   Temperature of column - 190°C

   Temperature of detector - 230°C

2. Barber-Colman Model 5360 with Tritium Detector for Chlorinated Hydrocarbons and Herbicides

   Sample - Organic solvent extract of water

   Size injected - usually 5 ul (5 microliters)

   Chart movement - 0.25 inches/minute

   Detector - Electron capture

Column packing - DC 200 - Anakrom ABS, 100/110 mesh

Carrier gas - Nitrogen

Column length - 6 feet

Outside diameter - 1/4 inch

Type - Glass

Sensitivity range - 300

Attenuator setting - 5

Recorder response range - One millivolt

Temperature of injector - 250°C

Temperature of column - 190°C

Temperature of Detector - 215°C

Tracer Analysis

1. Boron

Boron was analyzed using the Perkin-Elmer Model 403 atomic absorption spectrophotometer. The detection limit was 10 ppm.

2. Chlorides

Chlorides were tested for by the Argentometric Method. Reference: Standard Methods for the Examination of Water and Wastewater, p. 96, 13th Edition.

Gas Analysis

Laboratory examination were performed by the Water and Sewage Chemistry Section, Bureau of Laboratories, Maryland Department of Health and Mental Hygiene. Tests for the decomposition gases: methane, carbon dioxide, hydrogen sulfide, and ammonia were made on a Beckman Model GC7-5 instrument which employed the following columns and packings:

Column 1 - (Hydrogen sulfide, ammonia, and carbon dioxide)
  Column length - 6 feet
  Column material - Stainless steel with stainless fittings
  Outside diameter - 1/8 inch
  Column packing - Chromosorb 103, 80/100 mesh
  Carrier gas - Helium
  Detector - Helium ionization

Column 2 (Methane)
Column length - 6 feet
Column material - Stainless steel with stainless fittings
Outside diameter - 1/8 inch
Molecular sieve - 5A, 80/100 mesh
Detector - Thermal conductivity

Note: The foregoing columns were for a Beckman Model GC 72-5. Columns should be furnished with 1/4 inch Swagelok fittings for connection. The inside coil diameter of the columns should be six inches.

Microbiological Identifications

Several colonies were picked from plates for pure culture isolation and then determined by microbiological assay techniques, including:

1. GRAM NEGATIVE:	Triple Sugar Iron Agar, Indole, Nitrate Citrate, Urease, Voges-Proskauer, Oxidase, Methyl Red, and Motility Test.
2. AEROBIC SPORE FORMERS:	Gram and Spore Stains, Gelatin, Motility, Voges-Proskauer, Indole, Nitrate, Starch, Mannitol, and Colony Characteristics.
3. ANAEROBIC:	Gram Stain, Spore Stain, Thioglycollate Medium, Blood Agar, with Kannamycin, Clostrisel Agar, Indole-Nitrate, Gelatin, Litmus Milk, Motility Test, Dextrose, Lactose, Salicin, and Sucrose.

Other Miscellaneous Tests

All other chemical tests including nitrates, nitrites, ammonia, organic nitrogen, oils, greases, phenols, solids (all classes) were performed as outlined in the 12th Edition of Standard Methods for the Examination of Water and Wastewater of the American Public Health Association, American Water Works Association and Water Pollution Control Federation.

LANDFILL SETTLEMENT

FROSTBURG SITE NUMBER I

To measure the amount of landfill settlement on a completed segment of Frostburg Site No. 1, "floatable" concrete pads were constructed around the tops of the casings of landfill observation wells A, B, and C (refer to Map Number 5 for the locations of these wells).

The design allows for the free up-and-down movement of the concrete pads on the well casings. Since the casings were driven to a stable underlying geologic formation (coal seam), the rise or fall of the concrete pads should indicate the degree of movement of the deposited refuse.

The construction of the pads was completed on August 20, 1970. Elevations of each settlement pad were originally checked bi-monthly by the Allegany County Engineer; however, since the rate of settlement was so slow, elevations are now checked on an annual basis.

The results of the elevation determinations are as follows:

October 5, 1970

All pads rose from their original elevations during the first two months after construction. These rises were attributed to the frost heave, and in consideration of the climate in which the landfill is located, this would offset any possible settlement of the landfill occurring after the installation of the concrete pad-well casing system.

December 28, 1970

The elevations determined at this time indicated that all of the pads had risen slightly over their previous elevations.

March 11, 1971

Elevations reported on this date indicated that all pads had dropped an average of 0.15 feet.

May 25, 1971 and August 21, 1972

The elevations taken on these dates indicated that settling was continuing at a slow rate with the exception of the pad at observation well C. During the period between the two dates shown, it rose 0.17 feet. The reason for this is not readily apparent at this time.

The following is a summary of the settling results:

DATE	Pad elevations (Observation Well A)	Pad elevations (Observation Well B)	Pad elevations (Observation Well C)
May 5, 1970	2059.60	2059.27	2059.62
December 28, 1970	2059.68	2059.33	2059.85
March 11, 1971	2059.53	2059.15	2059.70
May 25, 1971	2059.50	2059.07	2059.43
August 21, 1972	2059.35	2058.88	2059.60

SETTLEMENT SURVEY

WESTERNPORT SITE NUMBER 2

In December 1970, the elevations of sixteen points were established on top of the completed Westernport site. At that time, the site had been completed, covered, graded, and seeded. While the points were randomly selected, they were chosen so as to cover the entire area of the landfill. In June 1971, the elevations of these same points were examined to determine the actual settlement of the fill over that period. The locations of each point and their changes in elevation are shown on the accompanying illustration.

No significant settling took place over the general survey area. However, it was apparent that the north side and the west toe of the area showed significant settling. It is believed that this can be attributed to the following. During the winter of 1970-1971, the diversion ditch along the north high wall was accidently blocked causing storm water from the adjacent hill to run directly into the landfill along the north edge. Flowing over the filled area, it seeped in and saturated the refuse and the subsurface flow was in the direction of the west toe. It is believed that the resulting saturation caused the subsequent settling. In those areas of the fill where good surface drainage was maintained, no significant settling was evident.

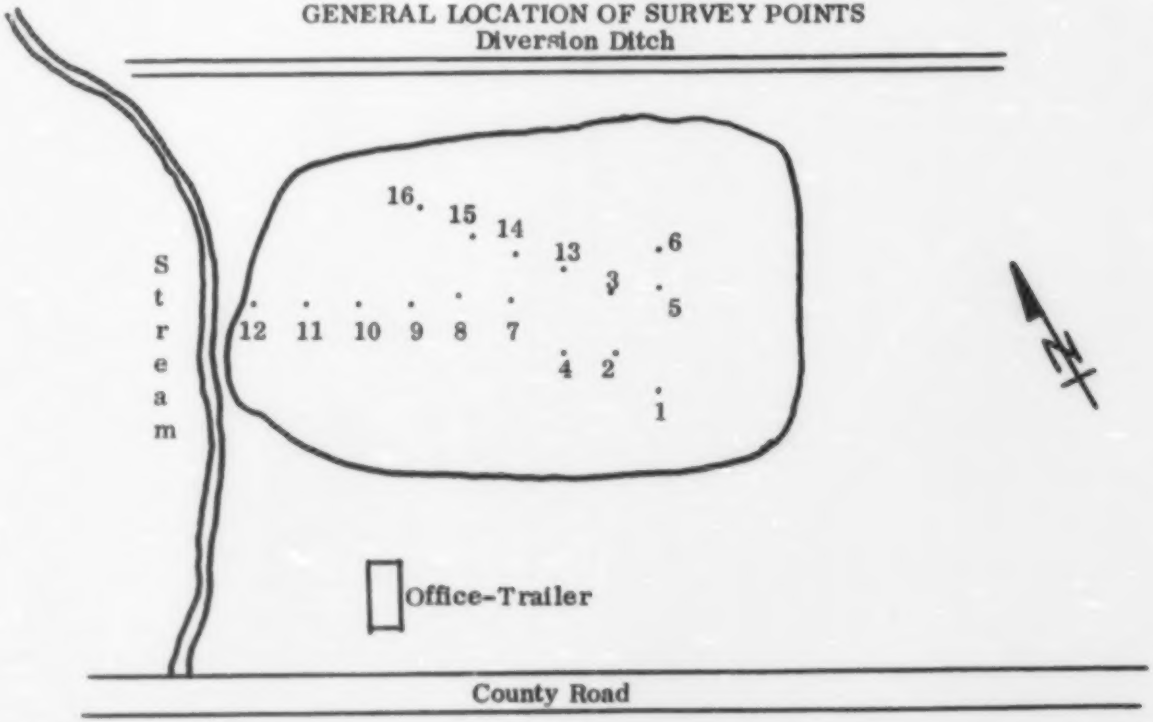
The settling that was evidenced amounted to approximately 10% of the original depth of the fill. However, this amount should not be considered standard.

WESTERNPORT SITE NO. 2
LANDFILL SETTLEMENT DATA

OBSERVATION POINT (NO.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CHANGE IN ELEVATION (FEET)	+0.18	-0.05	+0.21	-0.54	-0.05	+0.18	+0.19	+0.11	-0.12	-0.13	-1.10	-1.87	-1.86	-0.84	-2.05	-0.95

- Due to settlement of fill
+ Due to discing and reseeding of areas

GENERAL LOCATION OF SURVEY POINTS


Diversion Ditch
Stream
16
15
14
13
6
3
5
12
11
10
9
8
7
4
2
1
N
Office-Trailer
County Road

FROSTBURG SITE NUMBER I

VEGETATIVE COVER DEMONSTRATION

Six separate fields were developed on the Frostburg sanitary landfill as shown on Figure Number 15. Fields 1, 2, 3, and 6 were approximately one acre each, 4A and 4B were ½ acre tracts; and field 5 covered approximately two acres. Technical advice and assistance were provided by the Extension Agent, Allegany County Cooperative Extension Service of the University of Maryland.

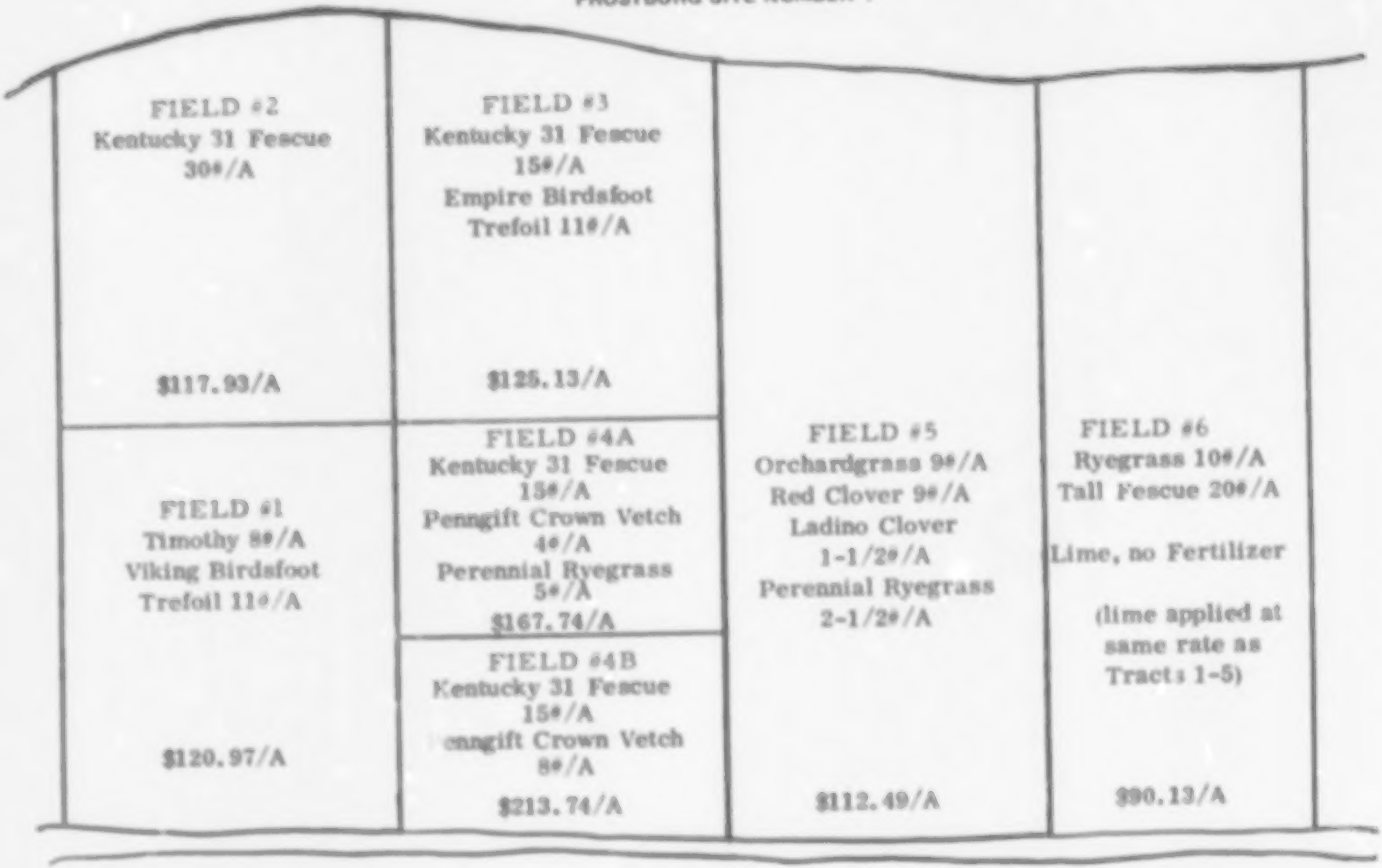
When test fields 3 and 5 had been filled to final grade with cover material and compacted, an additional three to five inches of fine loamy soil was applied prior to seeding. Composite soil samples were taken from the center of each quadrant of each field at a depth of eight to ten inches for testing at the University of Maryland Soil Testing Laboratory. The tests indicated that sufficient clay and silt particles were present to ensure good seed contact. Values of pH ranged from 5.8 to 6.1. Values of magnesium were high, but the phosphate content (as P_2O_5) and potassium (as K_2O) were in the low to medium ranges of those normally recommended for a seed bed. Tests for soil nitrogen are generally inadequate and normally not used in agricultural practice. However, most soils require additional nitrogen to support a good stand of vegetation.

Because the pH of the soil was generally uniform, all test fields received equal applications. Table Number 11 shows the amount of lime and fertilizers applied and the fertilizer analyses. The lime and fertilizer were mixed with the soil by two operations with a standard farm-type disc harrow. This operation brought stones to the surface, which were removed by hand to prevent their interference with the seeding operation. The fields were seeded on September 2, 1970, in the varieties and amounts shown on the charts.

The entire test area was prepared in one operation; therefore, the cost per acre for seedbed preparation is the same for all plots. The only difference in cost per acre for revegetation was the relatively small difference in seed prices. This uniformity of cost allows the revegetation to be readily evaluated by comparing rate of growth and survival.

FIGURE NUMBER 15

VEGETATIVE COVER DEMONSTRATION
FROSTBURG SITE NUMBER 1

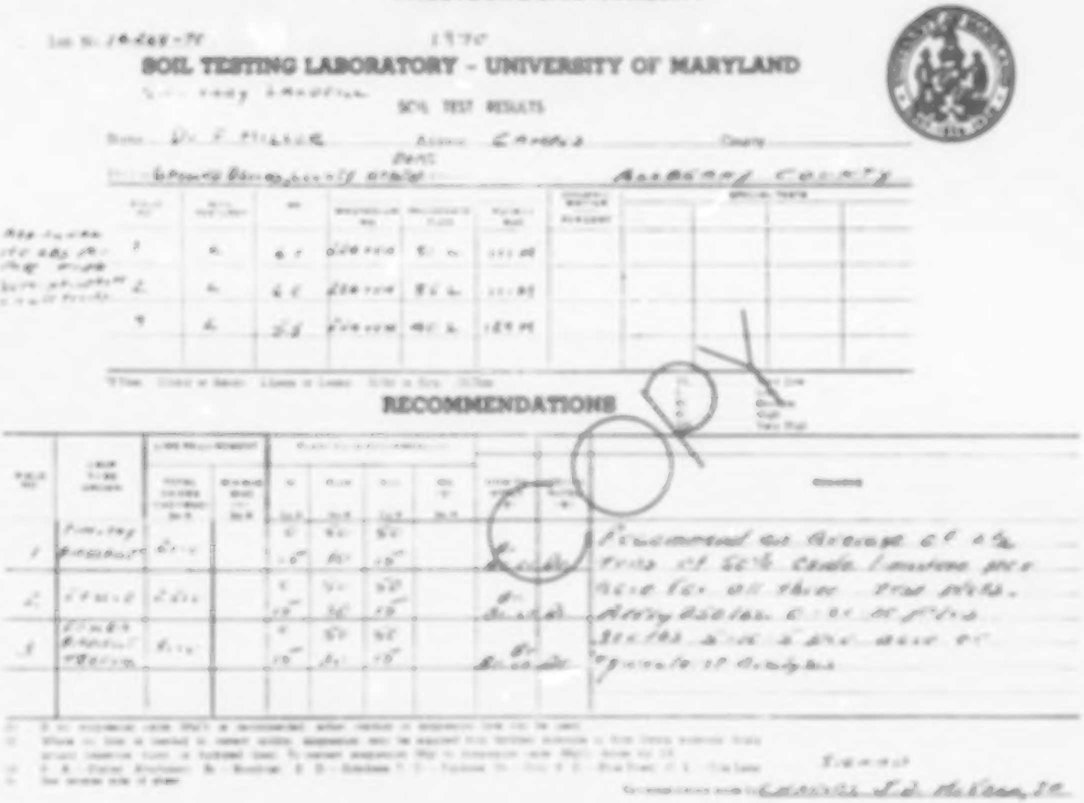

FIELD #2
Kentucky 31 Fescue
30#/A
$117.93/A
FIELD #3
Kentucky 31 Fescue
15#/A
Empire Birdsfoot
Trefoil 11#/A
$125.13/A
FIELD #1
Timothy 8#/A
Viking Birdsfoot
Trefoil 11#/A
$120.97/A
FIELD #4A
Kentucky 31 Fescue
15#/A
Penngift Crown Vetch
4#/A
Perennial Ryegrass
5#/A
$167.74/A
FIELD #4B
Kentucky 31 Fescue
15#/A
enngift Crown Vetch
8#/A
$213.74/A
FIELD #5
Orchardgrass 9#/A
Red Clover 9#/A
Ladino Clover
1-1/2#/A
Perennial Ryegrass
2-1/2#/A
$112.49/A
FIELD #6
Ryegrass 10#/A
Tall Fescue 20#/A
Lime, no Fertilizer
(lime applied at
same rate as
Tracts 1-5)
$90.13/A

NOTES:

1. Lime Application – September 1, 1970 – 17½ Tons total
or approximately 2½ Tons per acre.
2. Fertilizer Application – September 1, 1970 – 1 Ton (approximately 350 Lbs./A) – 0% Nitrogen, 20% Phosphorous, 20% Potassium;
1 Ton (approximately 350 Lbs./A) – 5% Nitrogen, 10% Phosphorous, 5% Nitrogen

TABLE NUMBER 11

SEEDING RECOMMENDATIONS – FINAL EARTH COVER
FROSTBURG SITE NUMBER I



1970

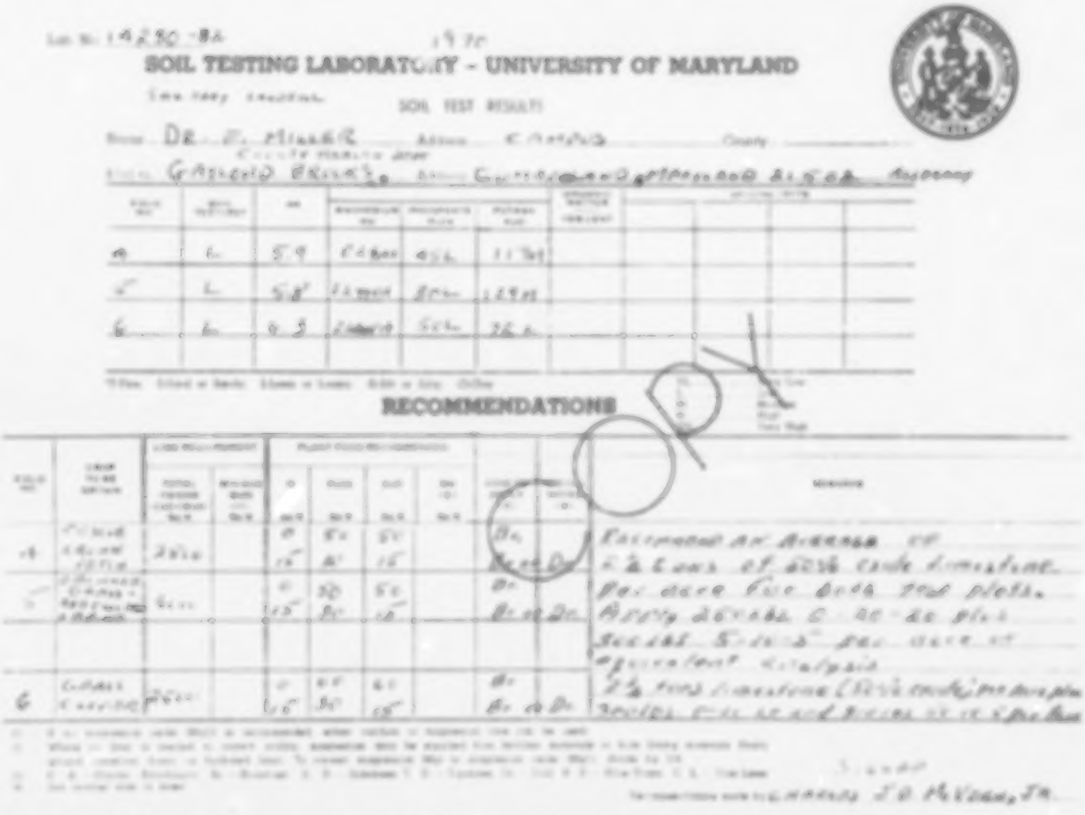
SOIL TESTING LABORATORY – UNIVERSITY OF MARYLAND

SOIL TEST RESULTS

Name DR. F. MILLER

RECOMMENDATIONS

COPY



1970

SOIL TESTING LABORATORY – UNIVERSITY OF MARYLAND

SOIL TEST RESULTS

Name DR. F. MILLER

RECOMMENDATIONS

COPY

NOTE: SEE REVERSE SIDE FOR "SPECIAL NOTES"

SPECIAL NOTES

Only numbers shown on front of page under "Special Notes" applies to your sample

1. Organic matter needed, apply manure, compost, green manure, etc. Work into surface soil or turn under 6 to 10 tons per acre in addition to fertilizer for maximum yields.
2. Turn one-half of limestone under. Work remainder thoroughly into surface soil.
3. Apply one-half of recommended amount of limestone now. Apply the other half within the next year or two.
4. Do not lime above pH 5.2 for potatoes or pH 5.6 for tobacco, because high pH favors scab development in potatoes and root rot in tobacco.
5. Because of the low lime content of this soil, it is safer to seed a mixture of grasses and legumes rather than alfalfa alone or else build up the lime content of the soil over a period of six months to one year before seeding alfalfa.
6. In the absence of a boron soil test the fertilizer should supply 1.5 to 2 pounds of boron per acre annually. When establishing alfalfa use fertilizer containing boron in the broadcast application only and work into the soil before seeding.
7. Use a starter solution in the transplanter tank.
8. Turn one-half of the fertilizer under. Work the remainder thoroughly into the surface soil.
9. Because neither field history nor information concerning crop to be grown was received with your sample, we cannot make specific recommendations. To obtain specific recommendations complete a field history sheet and return to us with the soil test results.

PLANT FOOD CONVERSION TABLES

Nitrogen

10 lbs. of nitrogen is supplied by any one of the following nitrogen fertilizers:

63 lbs. of nitrate of soda (16% N)
50 lbs. of sulfate of ammonia (20.5% N)
50 lbs. of ANL (20.5% N)
50 lbs of Cyanamid (20.6% N)
30 lbs. of ammonium nitrate (33.5% N)
22 lbs. of Urea (45% N)
12 lbs. of anhydrous ammonia (82% N)

Note: Liquid nitrogen solutions of varying nitrogen content may also be used.

Cyanamid should be used according to manufacturers directions or injury may result.

Magnesium

10 lbs. of magnesium (Mg) is supplied by any one of the following magnesium materials:

96 lbs. of Epsom salts (10.4% Mg*)

90 lbs. sulfate of Potash—Magnesia (21.8% K_2O and 11.1% Mg*)

55 lbs. Kieserite 18.1% Mg*)

23 lbs. Brucite (44.4% Mg*)

*Average Content

Note: Finely ground limestones, hydrated or burnt magnesium lime containing 6% or more magnesium (Mg) can also be used as sources of magnesium for plants. For further information on magnesium sources, contact your agricultural extension agent.

Boron

1 lb. of Boron (B) is supplied by any one of the following boron materials:

8.8 lbs. Borax (11.36% B)
7.0 lbs. Fertilizer Borate-46 (14.3% B)
5.0 lbs. Fertilizer Borate-65 (20.2% B)
4.9 lbs. Solubor (20.5% B)

Manganese

1 lb. of Manganese (Mn) is supplied by any one of the following manganese materials:

4.2 lbs. Manganese Sulfate (24% Mn)
3.9 lbs. Manganese Sulfate (25.5% Mn)
3.4 lbs. Manganese Sulfate (29.1% Mn)
2.1 lbs. Manganese Oxide (48% Mn)

Following the seeding operation, no artificial watering was performed in order to most nearly approximately normal sanitary landfill completion practices. The planting also coincided with a late fall drought during which less than half of the normal four inches per month rainfall was experienced. The results of the revegetation attempts are significant because of the generally adverse growing conditions that prevailed and because most reclaimed strip mines are expected to be re-established as natural hay and pasture land where only minimal maintenance can be provided. The initial growth response is important as a sanitary landfill since rapid revegetation will result in greater percolation and minimize erosion from rainwater runoff.

Field 1 was planted in viking bird's-foot trefoil and timothy. The first is a perennial legume which establishes itself slowly, but once established, has been known to survive for up to 20 years with proper management. Trefoil has a nitrogen-fixing ability and provides nitrogen compounds for its own use and for any companion crop. While the trefoil growth habit is erect, it tends to thicken laterally by rhizomes. Although normally adapted to wetlands, trefoil can also be expected to survive satisfactorily at higher and drier elevations when conditions are favorable. Timothy is a tall-growing, high-yielding perennial grass that is slow to germinate and requires a relatively fertile soil. Timothy is highly prized as a hay or forage crop.

This grass-legume mixture was slow to germinate and by the end of October 1970 had established only minimal top growth, which increased slightly by December. Although more favorable climatic conditions or watering may have increased the early top growth, this mixture must be considered unsuitable where quick germination and rapid growth are required.

By May 30, 1971, the vegetation was only two to three inches high, which is inadequate to allow its being considered as a landfill vegetative cover.

Field 2 was planted with Kentucky 31 fescue which, like timothy, is a tall-growing perennial grass used as both forage and hay. Kentucky 31 fescue germinates and grows rapidly, provides a dense tough turf, and has a high tolerance for poorer soils which makes it widely acceptable as a cover crop for critical areas when planted at rates of up to 60 pounds of seed per acre. Being a grass, the fescue does not fix nitrogen from the air and requires periodic applications of nitrogen compounds to keep it healthy.

The 30-pound per acre seeding rate applied on Field 2 provided a noticeable top growth within a few weeks of seeding, and a noticeable increase in ground cover was evident in October and November. Despite the maximum initial ground cover achieved under adverse weather conditions, a legume should probably be added to the seed mixture to avoid the high maintenance cost of periodic applications of nitrogen compounds. A legume-grass mixture would also offer better forage than the fescue alone.

Most of the vegetation died during the winter, and the tract was replanted with orchard grass in the spring of 1971. By May 30, the growth was heavy, and three to four inches of vegetation were visible. The change in seed mixture essentially prohibits an effective evaluation of the initial seed mix used on this tract.

Field 3 was planted with a mixture of Kentucky 31 fescue and empire bird's-foot trefoil. The latter is a low-growing pasture-type legume. The empire variety of trefoil showed a higher degree of germination and initial growth by the end of 1970 than it and the viking type normally achieve. This indicates that the soil had been enriched by the material from a nearby wooded area used as topsoil. This mixture also showed a heavy growth of three to four inches of vegetation by May 30, 1971.

Fields 4A and 4B were planted with a mixture of Penngift Crown vetch, Kentucky 31 fescue and perennial ryegrass. Crown vetch is a slow-starting perennial legume that attains medium height, grows densely and has a high soil-holding capacity. It is only now being considered as a forage crop by agronomists. But its tendency to thicken with lateral growth by rhizomes has caused it to be used extensively as a soil stabilizer on highway embankments. A seeding rate of 20 pounds per acre applied by hydroseeding and/or mulching has proven satisfactory in other areas for soil-stabilizing purposes, but a rate of four to eight pounds per acre was used on Fields 4A and 4B to experimentally evaluate the stabilizing benefit of this rate when added to the mixture. The perennial ryegrass is a quick-germinating, fast-growing grass which requires nitrogen fertilization but offers maximum growth and cover in a short period of time at relatively low seeding rates.

The fescue and perennial ryegrass germinated rapidly and provided good early cover, but no vetch growth was seen through December. The lack of evidence of the slower germinating vetch may have been caused by the dry conditions and low seed rates, which can be corrected by more costly application methods.

By May 30, 1971, Field 4A had a heavy growth of vegetation three to four inches high and Field 4B had a moderate growth that was two to three inches tall; very little vetch was present. The additional expense of this seed application defeats the desired purpose to develop the least-costly, acceptable revegetation procedure and seed mix.

Field 5 was planted in a mixture of orchard grass, red clover, ladino clover, and perennial ryegrass. Orchard grass is a tall-growing perennial grass widely used as a pasture grass in the northeastern United States. It germinates quickly, grows moderately fast if it has adequate moisture and warm temperatures, and forms clumps as the stand ages. Red clover is a biennial which attains a height of 18 to 20 inches and is adaptable to a wide range of soil types as long as the fertility level is relatively high. Red clover is a moderately fast-germinating and growing plant. Ladino clover is a quick-germinating, fast-growing perennial legume with a high moisture requirement. It has some adaptability to varying soil moisture conditions.

The mixture in Field 5 germinated quickly and appeared to be growing well in the early fall, but the growth rate soon fell off and there was minimal cover by December. By May 30, 1971, the entire tract had to be replanted. The plot was refertilized at the rate of 350 pounds of 5-10-5 and reseeded with orchard grass at the rate of 40 pounds per acre. Lime was applied at a rate of 2.75 tons per acre. Early growth was expected because of the characteristics of the seed varieties; a careful evaluation of the replanted area will be necessary after the 1971 growing season in order to properly evaluate the mixture. The initial evaluation indicates that it is unacceptable for the conditions at the site.

Field 6 was planted with a mixture of perennial ryegrass and tall fescue in an effort to combine quick germination and rapid growth in a legume and grass mixture. As expected, an early rapid growth developed but the soils' apparent lack of fertility and the lack of rain rapidly retarded the growth. By May 30, 1971, only a light growth of vegetation less than two inches high was evident. Tables 12, 13, and 14 show seeding costs.

TABLE NO. 12
FROSTBURG SITE NO. 1
SEEDING COST FOR ORIGINAL 8 ACRES

	SEED		LIME	SEED BED PRE-PARATION AND FINAL GRADING	LABOR	FERTI-LIZER	TOTAL
Field 1 1 acre	Timothy (8 lbs. at .23/lb.) Viking Birdsfoot Trefoil (1. lbs. at 1.20/lb.)	$ 1.84 13.20 $15.04	2.5 tons $19.80	$47.53	$17.80	560 lbs. $20.80	$120.97
Field 2 1 acre	Kentucky 31 Fescue (30 lbs. at .40/lb.)	$12.00	2.5 tons $19.80	$47.53	$17.80	560 lbs. $20.80	$117.93
Field 3 1 acre	Kentucky 31 Fescue (15 lbs. at .40/lb.) Empire Birdsfoot Trefoil (11 lbs. at 1.20/lb.)	$ 6.00 13.20 $19.20	2.5 tons $19.80	$47.53	$17.80	560 lbs. $20.80	$125.13
Field 4A 1/2 acre	Kentucky 31 Fescue (15 lbs. at .40/lb.) Penngift Crown Vetch (4 lbs. at 6.00/lb.) Perennial Ryegrass (5 lbs. at .20/lb.)	$ 6.00 24.00 1.00 $31.00	1.25 tons $9.90	$23.77	$8.80	280 lbs. $10.40	$83.87

	SEED	LIME	SEED BED PREPARATION AND FINAL GRADING	LABOR	FERTILIZER	TOTAL
Field 4B 1/2 acre	Kentucky 31 Fescue (15 lbs. at .40/lb. $ 6.00 Penngift Crown Vetch (8 lbs. at $6.00/lb.) $48.00 $54.00	1.25 tons $9.90	$23.77	$8.80	280 lbs. $10.40	$106.87
Field 5 2 acres	Orchardgrass (9 lbs. at .45/lb.) $ 4.05 Red Clover (9 lbs. at .71/lb.) 6.39 Ladino Clover (1-1/2 lbs. at 1.45/lb.) 2.18 Perennial Ryegrass (2-1/2 lbs. at .20/lb.) .50 $13.12	5 tons $39.60	$95.06	$35.60	1120 lbs. $41.60	$224.98
Field 6 2 acres	Ryegrass (10 lbs. at .20/lb.) $ 2.00 Ryegrass (20 lbs. at .40/lb.) 8.00 $10.00	5 tons $39.60	$95.06	$35.60	none used	$180.26

Total lbs. of seed	171-1/2 lbs.	Total cost of seed bed preparation and final grading	$380.25
Total cost of seed	$154.36	Total cost of labor	$142.20
Total tons of lime	20 tons	Total lbs. of fertilizer	3360 lbs.
Total cost of lime	$158.40	Total cost of fertilizer	$124.80

TOTAL COST - $960.01

TABLE NO. 13
FROSTBURG SITE NO. 1
RESEEDING COST FIELDS 2 AND 5

	SEED		LIME	EQUIPMENT	SPREADING	FERTILIZER		TOTAL
Field 2 1 acre	17 lbs. Kentucky 31 32 lbs. Rye 5 lbs. Ladino 2.5 lbs. Orchard	$4.80 $2.10 $ .62 $1.25	--			100 lbs. 5-10-10 40 lbs. Ammonia Nitrate 170 lbs. 46% Phosphate 110 lbs. Potash	$3.44 $ .44 $7.68 $3.85	
		$8.77	--	$29.90	$1.88		$15.41	$55.96
Field 5 2 acres	34 lbs. Kentucky 31 64 lbs. Rye 10 lbs. Ladino 5 lbs. Orchard	$9.60 $4.20 $1.24 $2.50	--			200 lbs. 5-10-10 80 lbs. Ammonia Nitrate 340 lbs. 46% Phosphate 110 lbs. Potash	$6.88 $ .88 $15.36 $2.70	
		$17.54	--	$59.80	$3.76		$25.82	$106.92

Total lbs. seed	169.5
Total cost seed	$26.31
Total cost equipment	$89.70

Total cost spreading	$5.64
Total cost fertilizer	$41.23
Total lbs. fertilizer	1150

TOTAL COST - $162.88

TABLE NO.14
FROSTBURG SITE NO. 1
SEEDING COST FOR ADDITIONAL 5 ACRES

	SEED		LIME	EQUIP-MENT	SPREAD-ING	FERTILIZER		TOTAL
5 Acre	85 lbs. Kentucky 31 160 lbs. Rye 25 lbs. Ladino 12.25 lbs. Orchard	$24.00 $10.50 $ 3.10 $ 6.25				500 lbs. 5-10-10 200 lbs. Ammonia Nitrate 850 lbs. 46% Phosphate 550 lbs. 60% Potash	$17.20 $ 2.20 $38.40 $19.25	
field	Total lbs. 282.25	$43.85	$177.65	$149.50	$9.40	Total lbs. 2100	$77.05	$457.45

ACID MINE DRAINAGE STUDIES

WESTERNPORT SITE NO. 2

One of the objectives of the demonstration project was to determine the effect of sanitary landfill operations on acid mine drainage. Such drainage results from the removal of surface or subsurface water, derived from mining operations, either by gravity flow or pumping. Acid in mine drainage results from iron pyrites (iron bisulfide) a mineral which is common in coal mining regions including the Westernport solid wastes disposal site. This mineral is converted to sulfuric acid by exposure to oxygen and water. Acid mine drainage thus formed, flows into surface drainage systems and lowers the pH of the water to a level which is not only detrimental to the survival of aquatic life but also causes unsightly accumulations of yellow compounds of iron on stream beds and banks. Neutralization of acid mine discharges by conventional chemical means would be a costly undertaking. It was reasoned, therefore, that consideration should be given to determining the effects that the components comprising solid waste would have in neutralizing, decolorizing, or producing other beneficial effects on acid mine drainage within reasonable economic limits. As a means of making this determination, it was decided to construct filter beds, collect the filtrate by means of underdrain systems, partially treat the filtrate by a settling tank-sand filter system and collect samples of the final effluent for laboratory analysis.

SITE SELECTION

Following these preliminary considerations, an attempt was made to locate an abandoned strip mine with the following requisites:

1. Acid water was flowing through the mine
2. The mine was small enough to be completely filled with refuse within from one to one and one half years.
3. The mine was located within a reasonable haul distance from refuse-producing areas.

Following extensive field explorations, a site which met all of the requisites, was finally located approximately three miles northwest of Westernport.

This stripped out area was about 200 feet long, 600 feet wide and contained about six feet of water in a pit fifty feet deep (See Map No. 4 for the location of the site). At the time of the visit, the flow of water through the mine was estimated to be about twenty gallons per minute and an immediate field test showed the water to be very acidic having a pH value of 3.2.

CONSTRUCTION OF MIXED REFUSE FILTER BEDS A AND B (1966-1969)

As a preliminary undertaking, two excavations each 100 by 16 feet in plan and from six to eight feet deep with bottoms sloping from the sides to the centers were made in virgin soil for the installation of the experimental filter bed systems. Each filter bed was prepared in the following manner. A longitudinal drainage trench, 2½ feet wide and 1 foot deep and sloping toward one end, was constructed along the center line at the bottom of the excavation. The trench was first lined with tar paper and then lined again with a layer of plastic sheet to prevent percolation of the filtrate into the ground. The bottom part of the main trench was then filled with a coarse acid resistant stone aggregate, varying in size from one to two inches, to a total depth of 18 inches from the bottom of the bed. The aggregate used was selected as a result of a study made by the State Water Resources Administration to determine the effect of acid mine drainage on various types of rocks. The filling of Filter Bed A was started on December 12, 1968 and completed on January 18, 1969. A total of 362,380 pounds of mixed domestic refuse was compacted in it and taking into account the dimensions of the bed, the density of the refuse was determined to be approximately 1000 pounds per cubic yard.

The preparation of Filter Bed B was started on July 16, 1969 and completed on July 30, 1969. It was filled with approximately 400,270 pounds of mixed domestic refuse which had a resultant compacted density of 1000 pounds per cubic yard. Both experimental filters were filled with mixed domestic refuse generated from the area served by the Westernport sanitary landfill which includes the Maryland communities of Bloomington, Westernport, McCoole, and the Keyser and Piedmont areas of West Virginia.

Twelve inches of Number 2 sandstone rock were spread evenly over the top of the compacted refuse. A wooden box structure approximately 2 feet wide and 2½ feet high was built along the centerline of the filter bed and a plastic liner was draped from the sides of the wooden box and over the layer of rocks to exclude surface water. Earth was then mounded over the top of the filter and firmly compacted in place. Crushed sandstone was then placed in the bottom of the box structure to support a four-inch diameter perforated plastic pipeline for use in dosing the filter bed with acid mine drainage. Finally, planks were placed over the top of the box to close it in. Refer to Figure No.17 which shows the cross section of a filter. A portable pump was used to draw water from the acid mine drainage stream through a 3/4 inch water meter and discharge it through a plastic hose into the end of the four-inch perforated distribution pipe in the wooden box structure. As may be seen from Figure No.16 the underdrains for the experimental filter beds were connected by a common drain line to a prefabricated concrete septic tank of 500 gallons capacity. This was the smallest commercially available tank and had more than an adequate capacity for its intended purpose, that of a sedimentation chamber only and not a settling sewage-digestion system normally associated with a septic tank installation. The effluent from the septic tank was then conducted by a pipeline to an open sand filter, 21 feet by 21 feet in plan and designed to handle 500 to 1000 gallons of sewage daily. Again it is emphasized that the filter was being used as a sediment strainer only and not as a part of a sewage treatment and disposal system. This filter was constructed in accordance with the design standards of the State Department of Health and Mental Hygiene and installed, under the provisions of a permit from the Allegany County Health Department. A pipeline was installed to conduct the filter effluent to another septic tank which served as a chlorine contact chamber. Here, the filtrate was chlorinated and held for a period of time prior to discharge into a nearby stream.

CONSTRUCTION OF INDUSTRIAL REFUSE FILTER BEDS NOS. 1, 2, 3 and 4 (1969-1971)

During the fourth and fifth year, four industrial refuse filter beds were constructed at the Westernport facility. The construction of these beds generally followed the procedure outlined for mixed refuse beds A and B, with the exception of the individual leachate collection boxes.

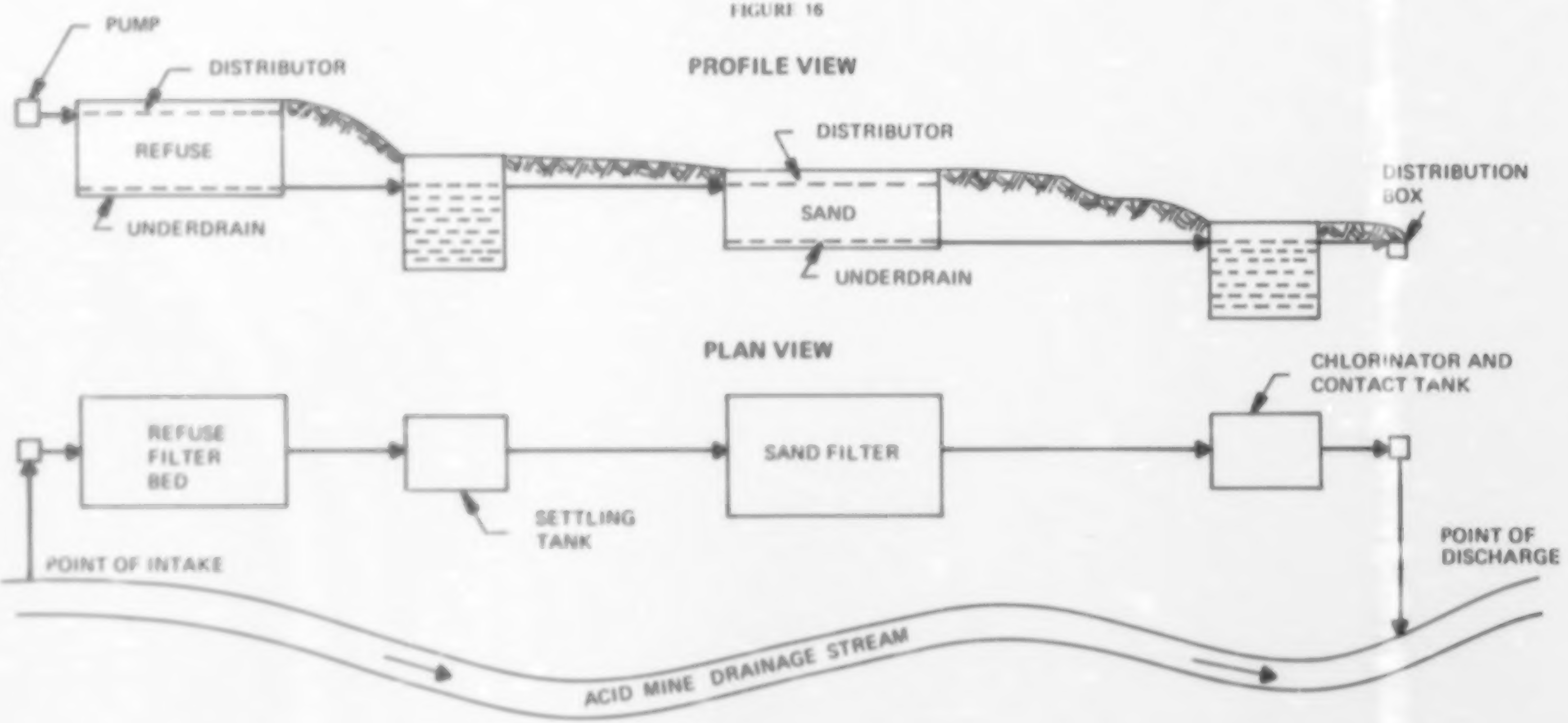
RESULTS OF EXAMINATIONS OF FILTER BED EFFLUENTS

Filter Bed A

Preliminary tests were initiated on Filter Bed A on June 10, 1968 when it received an initial charge of acid mine drainage. Due to the high density of the filter media, subsequent rechargings were made before any appreciable flow resulted on the effluent side of the filter. Laboratory tests performed on samples of water

SCHEMATIC DRAWING OF AN EXPERIMENTAL FILTER BED
WESTERNPORT SITE NUMBER 1

FIGURE 16


PUMP
DISTRIBUTOR
PROFILE VIEW
REFUSE
UNDERDRAIN
DISTRIBUTOR
SAND
UNDERDRAIN
DISTRIBUTION BOX
PLAN VIEW
REFUSE FILTER BED
SETTLING TANK
SAND FILTER
CHLORINATOR AND CONTACT TANK
POINT OF INTAKE
POINT OF DISCHARGE
ACID MINE DRAINAGE STREAM

NOT TO SCALE

DRAWING NO. 1
WESTERNPORT SITE NO. 2
EXPERIMENTAL FILTER BED

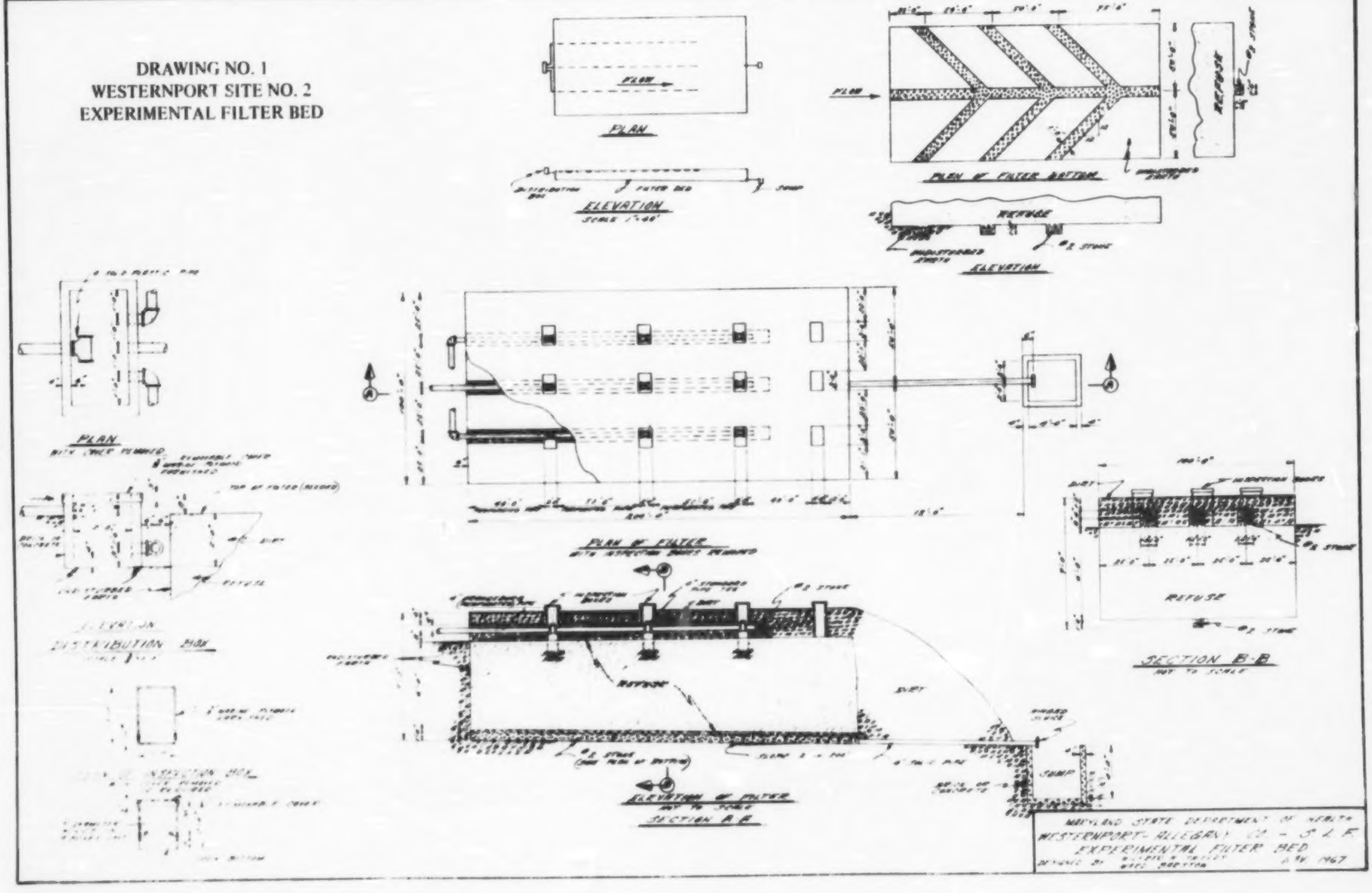
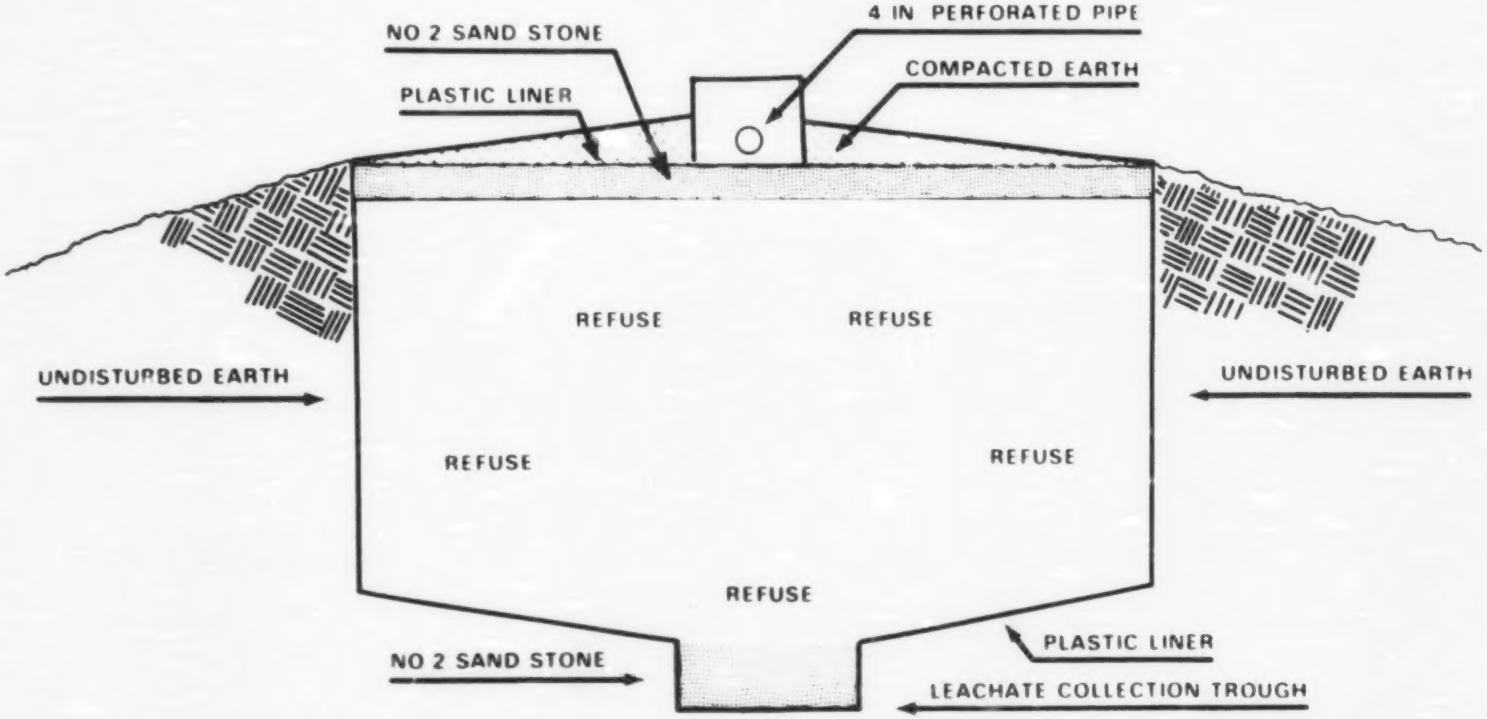
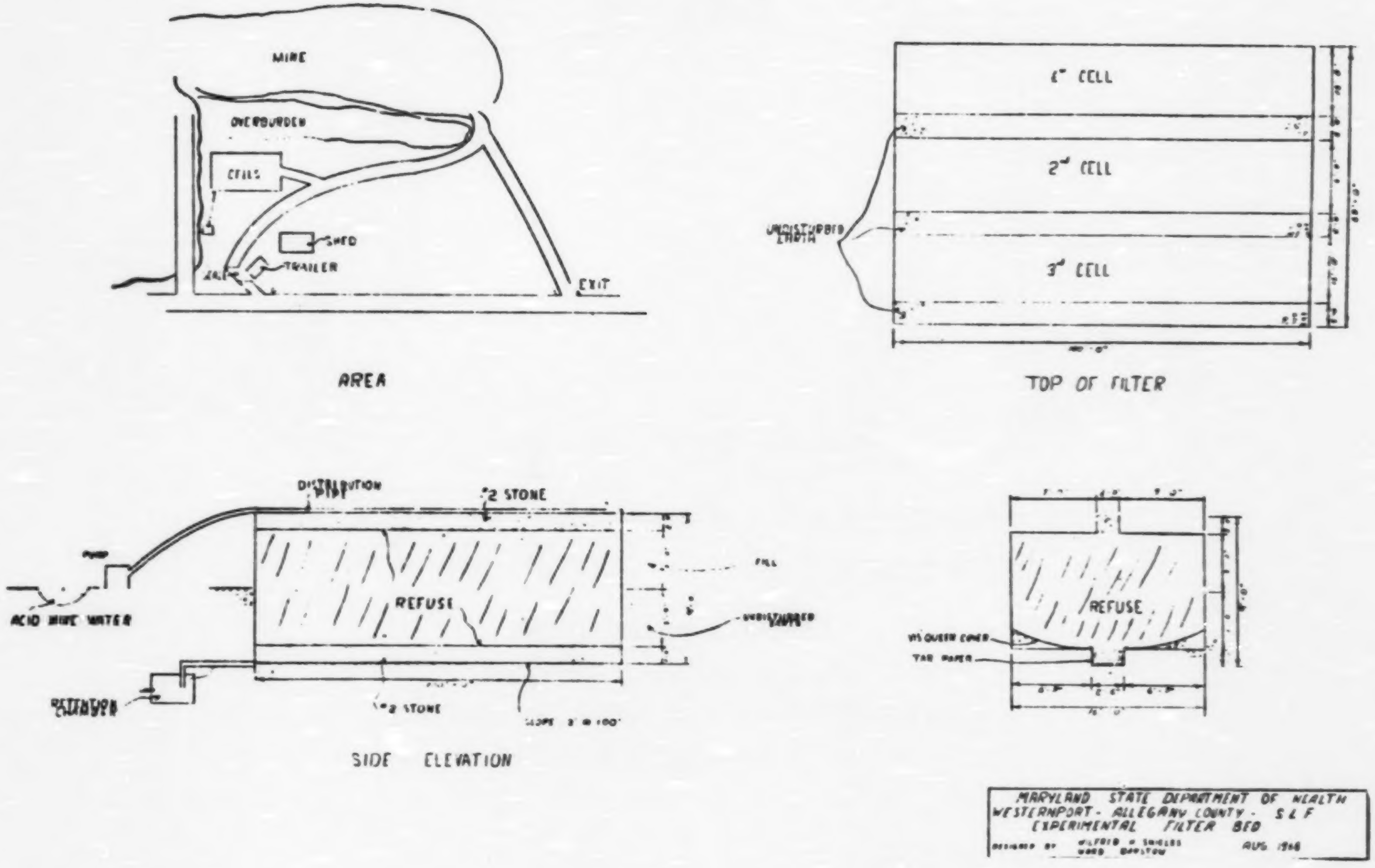

PLAN
FLOW
ELEVATION
SCALE 1"=40'
FILTER BED
SUMP
PLAN OF FILTER BOTTOM
FLOW
REFUSE
UNDISTURBED EARTH
#2 STONE
ELEVATION
PLAN
DISTRIBUTION BOX
INSPECTION BOX
PLAN OF FILTER
DIRT
REFUSE
INSPECTION BOXES
SECTION B-B
NOT TO SCALE
ELEVATION OF FILTER
NOT TO SCALE
SECTION A-A
SUMP
MARYLAND STATE DEPARTMENT OF HEALTH
WESTERNPORT- ALLEGANY CO. - S.L.F.
EXPERIMENTAL FILTER BED
1967

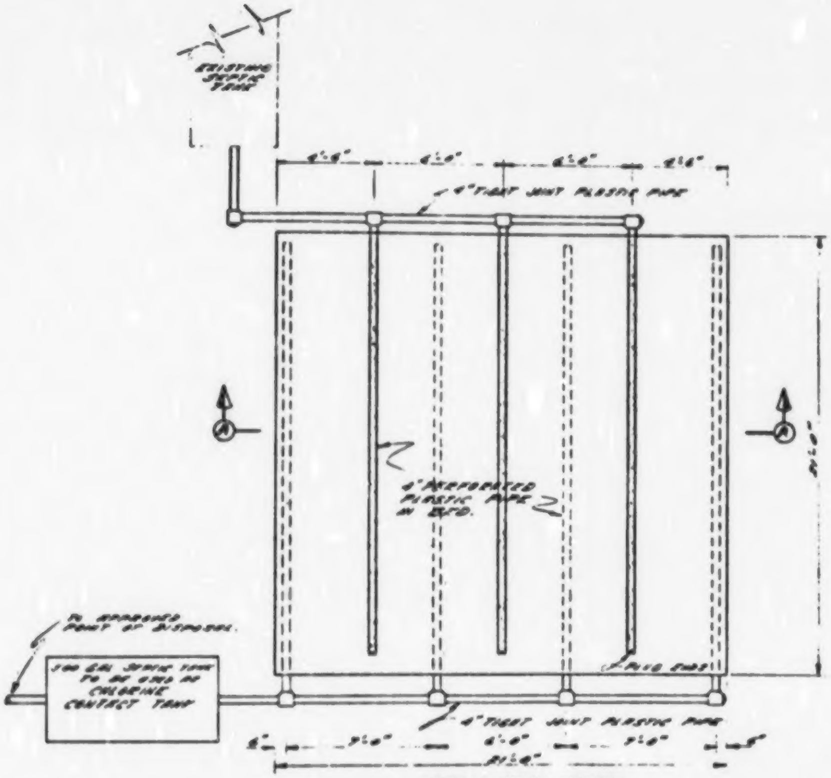
FIGURE NUMBER 17
CROSS SECTION OF EXPERIMENTAL
REFUSE CONTACT BED
(ACID MINE WATER)


NO 2 SAND STONE
4 IN PERFORATED PIPE
PLASTIC LINER
COMPACTED EARTH
REFUSE
REFUSE
UNDISTURBED EARTH
UNDISTURBED EARTH
REFUSE
REFUSE
REFUSE
PLASTIC LINER
NO 2 SAND STONE
LEACHATE COLLECTION TROUGH

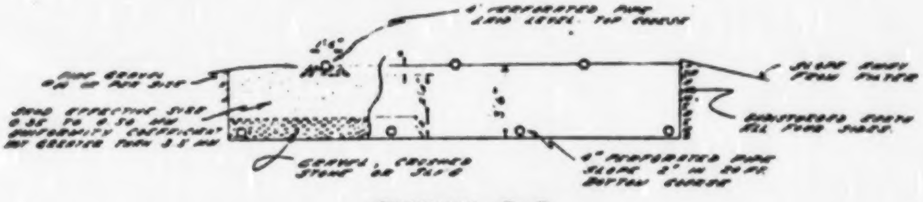
DRAWING NO. 2
EXPERIMENTAL FILTER BED
ACID MINE DRAINAGE STUDIES
WESTERNPORT SITE NO. 2


MINE
OVERBURDEN
CELLS
SHED
TRAILER
EXIT
AREA
1st CELL
2nd CELL
3rd CELL
UNDISTURBED EARTH
TOP OF FILTER
DISTRIBUTION PIPE
#2 STONE
PUMP
ACID MINE WATER
REFUSE
FILL
UNDISTURBED EARTH
RETENTION CHAMBER
#2 STONE
SLOPE 3" @ 100'
SIDE ELEVATION
VISQUEEN COVER
TAR PAPER
REFUSE
MARYLAND STATE DEPARTMENT OF HEALTH
WESTERNPORT - ALLEGANY COUNTY - S & F
EXPERIMENTAL FILTER BED
DESIGNED BY WILFRED H SHIELDS
WARD BARSTOW
AUG 1968

DRAWING NO. 3
WESTERNPORT SITE NO. 2
OPEN SAND FILTER
ACID MINE DRAINAGE STUDY


EXISTING SEPTIC TANK
4'-6"
6'-0"
6'-0"
4'-6"
4" TIGHT JOINT PLASTIC PIPE
4" PERFORATED PLASTIC PIPE IN BED.
21'-0"
TO APPROVED POINT OF DISPOSAL
500 GAL SEPTIC TANK TO BE USED AS CHLORINE CONTACT TANK
PLUG ENDS
4" TIGHT JOINT PLASTIC PIPE
5"
7'-0"
6'-0"
7'-0"
5"
21'-0"

OPEN SAND FILTER
SCALE 1/8"=1'-0"


4" PERFORATED PIPE LAID LEVEL TOP COURSE
2'-0"
PEA GRAVEL 1/4 IN OR PEA SIZE
SAND EFFECTIVE SIZE 0.35 TO 0.50 MM UNIFORMITY COEFFICIENT NOT GREATER THAN 3.5 MM
GRAVEL, CRUSHED STONE OR SLAG
4" PERFORATED PIPE SLOPE 3" IN 20 FT. BOTTOM COURSE
SLOPE AWAY FROM FILTER
UNDISTURBED EARTH ALL FOUR SIDES

SECTION A-A
SCALE 1/8"=1'-0"

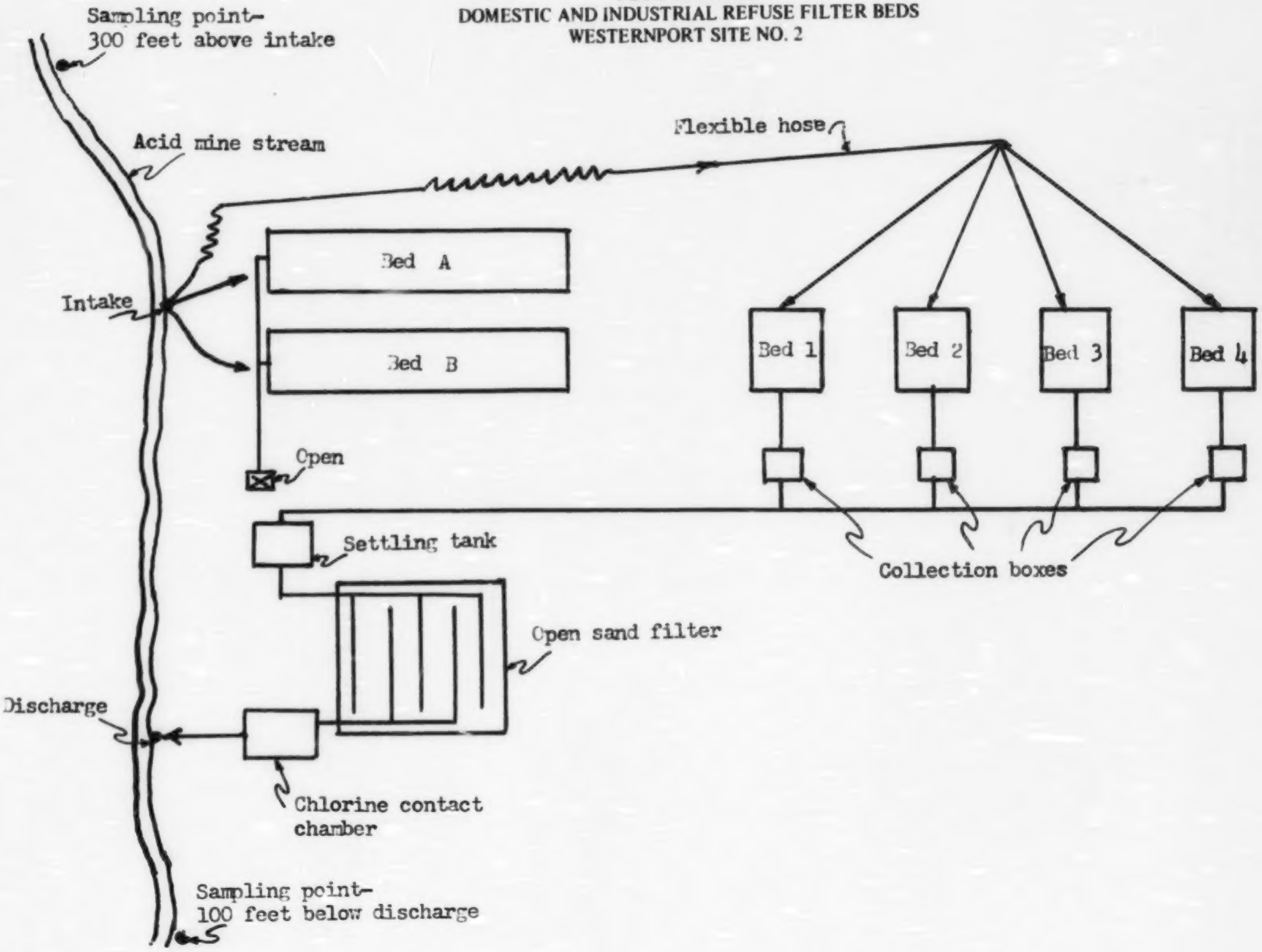
DESIGN

FILTER BED 21'x21' = 441 ☐'
SAND TO HANDLE 500 TO 1000 gal/day,
MAX 1.0 - 1.5 gal/☐'/day.

DRAWING 2 OF 2

MARYLAND STATE DEPARTMENT OF HEALTH
OPEN SAND FILTER
LANDFILL #2 - WESTERNPORT -
ALLEGANY CO APR 1969

FIGURE NO. 18
FLOW DIAGRAM
DOMESTIC AND INDUSTRIAL REFUSE FILTER BEDS
WESTERNPORT SITE NO. 2


Sampling point-
300 feet above intake
Acid mine stream
Flexible hose
Intake
Bed A
Bed B
Bed 1
Bed 2
Bed 3
Bed 4
Open
Settling tank
Collection boxes
Open sand filter
Discharge
Chlorine contact
chamber
Sampling point-
100 feet below discharge

collected from the acid mine drainage stream and the effluent from the settling tank prior to sand filtration proved quite encouraging so far as acid neutralization is concerned. As may be noted, the pH of the acid mine drainage rose appreciably as it flowed through the system, going from a value of 3.6 to 6. Considerable iron was picked up, presumably from contact with ferrous materials in the refuse. Some undesirable chemical, physical, and biochemical qualities became manifest such as increased organic loadings, color and odors.

Filter Bed B

Filter B was completed but tests were not performed because of the lack of qualified personnel to do the work. Early in 1971 a visit to the Westernport site by an EPA project officer resulted in a request to continue sampling of filter bed B until the end of the project in October 1971. The results of the examinations of the samples collected are shown in Table No.15.

Industrial Filter Beds 1,2,3 and 4

As many samples as possible were collected from these beds, before the termination of the project, to determine what type of short-term chemical activity was occuring in each bed. Please refer to Table No.   for the results of the examination of these samples.

To date, no valid conclusions have been reached with existing data. However, continued analysis of samples beyond termination of the project is planned. These refuse filter beds must be looked at from a long-term point of view. Percolation of acid water through various types of solid waste may provide a reasonable solution to the acid mine drainage problems in these Appalachian areas, since conventional chemical treatment methods can prove quite costly.

TABLE NO. 15
EXPERIMENTAL CONTACT BED TESTS
WESTERNPORT SITE NO. 2
RESULTS OF LABORATORY EXAMINATIONS OF WATER SAMPLES

DATE	LABORATORY NUMBER	SOURCE	p H (FIELD)	p H (LABORATORY)	TOTAL RESIDUE	VOLATILE RESIDUE	COLOR	TURBIDITY	DISSOLVED OXYGEN	OXYGEN DEMAND (BIOCHEMICAL)	ALKALINITY	ACIDITY	HARDNESS	CHLORIDE	IRON	MANGANESE	ALUMINUM	SULFATE
					mg/l	mg/l	UNITS	UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
6/3/71	WMC 7108	Acid Mine Stream (300 Feet above intake)	3.6	6.2	13,883	1961	70	180	2.2	106	56	134	1350	30	46	11	6	1600
6/9/71	WML 7114	do.	3.6	5.4	2366	1996	150	150	2.6	121	32	40	1220	24	34	11.8	—	1350
5/28/71	WML 7146	do.	—	5.1	2154	1794	60	60	4.0	1.5	6	100	4000	26	24	10	—	1300
7/7/71	WMA 7203	do.	—	4.7	2426	1940	40	90	5.0	5.1	2	76	1940	20	21	13.8	—	1600
7/22/71	524	do.	3.6	4.3	2068	—	—	—	—	—	-29	—	82	5.6	15	13	3.8	859
8/3/71	WMB 7202	do.	—	3.6	2232	1851	40	80	4.2	10	0	130	1170	17	20	13.2	—	1450
8/18/71	7221	do.	3.8	5.2	2208	1848	210	93	3.7	18	8	100	1280	15	25	9.6	—	1475
9/8/71	WMC 7209	do.	3.7	6.0	2582	2294	75	98	3.8	100	50	310	1320	28	41	12.8	—	1500
9/22/71	WMC 7218	do.	3.4	4.6	2335	1953	210	83	3.4	72	1	150	1210	22	24	1.3	—	1060
10/7/71	WMD 7203	do.	3.4	6.3	2105	1841	30	60	6.8	<60	76	80	4500	24	18.5	11.4	—	1300
6/28/71	—	Intake	—	6.0	2547	1949	400	150	.4	219	150	20	1500	38	28	9	—	1350
7/7/71	WMA 7203	do.	—	6.5	2625	2183	300	230	2.4	183	72	34	1100	25	33	13.2	—	1600
7/22/71	525	do.	—	6.5	2334	—	—	—	—	—	62	—	441	9	.5	14	1.5	790
8/3/71	WMB 7202	do.	—	3.6	2232	1851	40	80	4.2	10	0	130	1170	17	20	13.2	—	1450
8/4/71	WMB 7201	do.	—	6.1	2491	2247	80	110	2.8	117	60	46	1320	20	30	14	—	1400
8/18/71	WMB 7221	do.	3.8	5.9	2367	1931	250	110	1.7	168	72	20	1470	22	47	11.2	—	1475
9/8/71	WMC 7209	do.	3.8	5.5	2537	2255	180	112	4.2	136	52	106	1350	20	39	13.6	—	1300
10/7/71	WMC 7218	do.	3.6	5.1	2546	2126	270	150	4.0	99	12	150	1400	24	44	1.3	—	1550
10/7/71	WMD 7203	do.	3.5	6.0	2363	2036	40	160	3.6	102	88	84	3000	24	36.5	11	—	1550
7/7/71	WMA 7203	Contact Bed. No. 1	—	—	—	—	—	1000	—	10,200	—	1420	—	—	—	—	—	—
8/3/71	WMB 7202	do.	—	5.9	35,969	32,905	200	5000	—	<600	624	0	—	—	—	—	—	—
8/18/71	WMB 7221	do.	—	6.1	10,010	8,179	—	—	—	360	1360	—	—	—	—	—	—	—
9/8/71	WMC 7209	do.	—	5.8	8176	7,171	200	5000	—	2181	1000	0	—	—	—	—	—	—
9/22/71	WMC 7218	do.	—	5.7	10,676	9,912	200	5000	—	256	760	0	—	—	—	—	—	—

– NO RESULT

DATE	LABORATORY NUMBER	SOURCE	p H (FIELD)	p H (LABORATORY)	TOTAL RESIDUE	VOLATILE RESIDUE	COLOR	TURBIDITY	DISSOLVED OXYGEN	OXYGEN DEMAND (BIOCHEMICAL)	ALKALINITY	ACIDITY	HARDNESS	CHLORIDE	IRON	MANGANESE	ALUMINUM	SULFATE
					mg/l	mg/l	UNITS	UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
10/7/71	WMD 7203	do.	—	6.1	5984	5,120	100	5000	—	<1000	160	0	—	—	—	—	—	—
6/3/71	WML 7108	Contact Bed No. 2	—	4.7	18,036	12,292	—	—	0	74,000	452	2520	—	—	352	—	—	—
5/9/71	WML 7114	do.	—	3.8	31,263	25,314	—	—	0	6,893	0	3380	—	—	—	—	—	—
6/28/71	WML 7145	do.	—	4.8	34,646	27,976	—	—	—	6,125	2100	3380	—	—	—	—	—	—
7/7/71	WMA 7203	do.	—	5.1	56,486	47,902	400	1,000	—	12,450	760	2920	—	—	—	—	—	—
7/22/71	530	do.	—	6.1	7,926	—	—	—	—	—	967	—	93	165	650	22	1.5	—
8/4/71	WMB 7201	do.	—	4.7	51,254	45,338	200	5,000	—	6,525	1012	3016	—	—	—	—	—	—
8/18/71	WMB 7222	do.	—	4.3	33,244	23,869	600	5,000	—	9,600	0	1720	—	—	—	—	—	—
9/8/71	WMC 7210	do.	—	4.9	21,397	12,195	200	5,000	—	15,818	2240	5000	—	—	—	—	—	—
9/22/71	WMC 7219	do.	—	4.5	23,760	14,253	200	5,000	—	27,180	0	4200	—	—	—	—	—	—
10/7/71	WMD 7204	do.	—	4.6	33,295	—	200	5,000	—	14,400	2360	3700	—	—	—	—	—	—
6/3/71	WML 7108	Contact Bed No. 3	—	6.2	7318	6,297	—	—	0	56	346	26	—	—	50	—	—	1450
6/9/71	WML 7114	do.	—	5.1	13,329	11,926	—	—	0	>100	162	64	—	—	—	—	—	—
6/28/71	WML 7145	do.	—	5.9	8,634	7,317	—	—	—	136	700	60	—	—	—	—	—	—
7/7/71	WMA 7304	do.	—	6.6	27,069	24,743	500	1,000	—	—	500	40	—	—	—	—	—	—
7/22/71	526	do.	—	6.7	11,327	—	—	—	—	—	366	—	—	10	90	12	.5	67
8/4/71	WMB 7201	do.	—	6.2	36,255	32,757	100	5,000	—	169	410	0	—	—	—	—	—	—
8/18/71	WMB 7222	do.	—	6.0	12,062	9,618	150	5,000	—	2,640	450	—	—	—	—	—	—	—
9/8/71	WMC 7210	do.	—	6.0	8,101	7,150	200	5,000	—	1,090	420	62	—	—	—	—	—	—
9/22/71	WMC 7219	do.	—	5.6	10,620	8,942	250	5,000	—	—	236	310	—	—	—	—	—	—
10/7/71	WMD 7204	do.	—	5.1	9,977	—	100	5,000	—	180	700	52	—	—	—	—	—	—
6/3/71	WML 7109	Contact Bed No. 4	—	5.8	13,883	9,813	—	—	0	1,518	3,140	500	—	—	300	—	—	800
6/9/71	WML 7115	do.	—	5.5	14,327	10,413	—	—	0	—	800	480	—	—	—	—	—	—
6/28/71	WML 7146	do.	—	5.4	35,385	29,976	—	—	—	3,840	2,100	540	4000	26	24	—	—	—
7/7/71	WMA 7304	do.	—	6.4	10,961	—	—	1,000	—	3,660	960	500	—	—	—	—	—	—
7/22/71	527	do.	—	5.0	45,262	—	—	—	—	—	424	—	169	89	425	0	26	404
8/3/71	WMB 7202	do.	—	5.8	43,113	38,713	200	5,000	—	3,645	774	124	—	—	—	—	—	—

– NO RESULT

DATE	LABORATORY NUMBER	SOURCE	p H (FIELD)	p H (LABORATORY)	TOTAL RESIDUE	VOLATILE RESIDUE	COLOR	TURBIDITY	DISSOLVED OXYGEN	OXYGEN DEMAND (BIOCHEMICAL)	ALKALINITY	ACIDITY	HARDNESS	CHLORIDE	IRON	MANGANESE	ALUMINUM	SULFATE
					mg/l	mg/l	UNITS	UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8/18/71	WMB 7222	do.	—	5.2	10,994	5,887	—	—	—	4,500	4,300	500	—	—	—	—	—	—
9/8/71	WMC 7210	do.	—	5.2	6,468	3,025	200	5,000	—	2,045	1,900	308	—	—	—	—	—	—
9/22/71	WMC 7219	do.	—	5.7	17,280	13,909	300	5,000	—	1,479	1340	680	—	—	—	—	—	—
10/7/71	WMD 7204	do.	—	4.6	22,649	18,175	—	5,000	—	1,800	2280	364	—	—	—	—	—	—
9/4/68	—	Contact Bed "A"	2.6	—	235	—	—	115	.4	893	392	—	2,200	—	110	31.2	34	1675
9/10/68	—	do.	3.1	—	3357	—	—	28	1.2	13	0	312	2,100	—	59	26.4	20.5	2000
9/19/68	—	do.	3.4	—	3566	—	—	75	1.4	3	0	523	2,100	—	50	23.2	16	2000
9/24/68	—	do.	3.1	—	3524	—	—	120	1.0	3.9	0	590	2,020	—	53	34	18	1800
11/7/68	—	do.	3.1	—	3316	—	—	35	4.0	4.2	0	480	2,000	—	55	2.9	25	2500
7/1/68	—	Settled Effluent From Contact Bed "A"	5.6	—	46,792	—	60	320	—	—	4,881		673	937	1200	—	—	—
7/16/68	—	do.	5.6	—	21,842	—	500	180	—	—	3,596		—	834	650	—	—	—
8/11/68	—	Sand Filtered Effluent from Contact Bed "A"	6.5	—	13,259	—	—	—	0	17,093	3,980	1800	—	—	—	0	—	—
9/4/68	—	do.	5.7	—	3,860	—	—	400	0	8,643	1,390	3550	4300	—	575	0	45	675
9/10/68	—	do.	6.1	—	10,445	—	—	450	0	9,193	4,450	1180	3800	—	520	0	32	500
9/19/68	—	do.	5.8	—	12,032	—	—	1500	0	8,618	5,400	1600	5100	—	410	0	34	225
9/24/68	—	do.	5.8	—	12,454	—	—	1500	0	7,792	4,600	1480	5100	—	445	0	37	250
11/7/68	—	do.	6.2	—	11,062	—	—	500	0	8,324	1,200	3800	4100	—	293	0	10	310
7/1/68	—	Contact Bed "A" After Chlorine Contact	6.0	—	9,770	—	45	90	—	—	—	—	—	497	600	—	—	—
7/16/68	—	do.	5.9	—	13,142	—	55	120	—	—	—	—	117	699	600	—	—	—
7/1/68	—	Acid Mine Stream-After "A"	3.7	—	3,274	—	25	20	—	—	-44	—	—	42	75	386	—	—
7/16/68	—	do.	3.6	—	3304	—	37	37	—	—	-163	—	—	18	85	883	—	—
6/31/71	WML 7108	Contact Bed "B"	—	5.3	13,601	6863	—	—	0	1,162	3340	3800	—	—	—	—	—	650
6/9/71	WML 7114	do.	—	4.9	12,859	6393	—	—	—	75,000	1000	3960	—	—	—	—	—	—
6/28/71	WML 7145	do.	—	4.9	30,781	21,940	—	—	—	11,100	2800	3180	—	—	—	—	—	—
7/7/71	WMA 7203	do.	—	5.0	—	—	—	1000	—	10,200	—	1420	—	—	—	—	—	—
8/18/71	WMB 7221	do.	—	5.4	—	—	—	—	—	12,000	6400	1600	—	—	—	—	—	—
9/22/71	WMC 7218	do.	—	4.5	9323	5,016	300	5000	—	10,678	0	2300	—	—	—	—	—	—
10/7/71	WMD 7203	do.	—	4.7	9611	4,765	—	500	—	7,500	2680	1790	—	—	—	—	—	—
6/3/71	WMC 7108	Acid Mine Stream (100 Feet below intake)	3.8	6.2	2482	2,050	60	205	2.0	101	50	54	1270	26	56	11	0	1200

– NO RESULT

DATE	LABORATORY NUMBER	SOURCE	p H (FIELD)	p H (LABORATORY)	TOTAL RESIDUE	VOLATILE RESIDUE	COLOR	TURBIDITY	DISSOLVED OXYGEN	OXYGEN DEMAND (BIOCHEMICAL)	ALKALINITY	ACIDITY	HARDNESS	CHLORIDE	IRON	MANGANESE	ALUMINUM	SULFATE
					mg/l	mg/l	UNITS	UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
6/9/71	WML 7114	do.	3.8	5.2	2588	2,145	140	275	3.0	185	44	70	1200	30	36	13.6	—	1300
6/28/71	WMC 7145	do.	—	6.0	2533	1,980	700	220	.8	282	172	20	1800	36	36	9.	—	1350
7/7/71	WMA 7203	do.	—	6.1	2575	2,065	300	180	1.7	234	56	22	1220	22	40	13.6	—	1600
7/22/71 8/4/71	523 WMB 7201	do. do.	— —	6.5 6.0	15,190 2,496	— 2215	— 40	— 120	— 3.0	— 138	207 65	— 50	422 1300	257 25	170 36	56 14	78 —	600 1525
8/18/71	WMB 7221	do.	3.8	6.1	2,226	1964	100	155	1.7	180	90	34	1510	24	42.5	0	—	1475
9/8/71	WMC 7209	do.	3.8	5.9	2,669	2295	—	125	1.8	>105	82	112	1310	24	43.5	13.6	—	1300
9/22/71	WMC 7218	do.	3.5	5.2	2,808	2426	250	245	2.6	177	22	178	1450	30	138	1.3	—	1300
10/7/71	WMD 7203	do.	3.4	5.9	2,422	2067	50	220	3.2	117	90	340	3000	24	40	1.8	—	1500

— NO RESULTS

FROSTBURG SITE NO. 1

BROCHURE FOR VISITORS

THE ALLEGANY COUNTY SANITARY LANDFILL DEMONSTRATION PROJECT

The Allegany County Sanitary Landfill is a joint project of Allegany County, the State of Maryland and the Federal Government. It was started in 1966, with a grant from the U.S. Public Health Service (continued through U.S. Environmental Protection Agency), to show that abandoned strip mines can be used safely, efficiently, economically and attractively for disposal of solid wastes. It has been in use for four years and now operates 10 hours daily, six days weekly. It serves 50,000 persons and receives about 270 tons of solid waste a day.

Why use a strip mine? There are several advantages: availability of a large trench, with cover material nearby; already constructed roads suitable for heavy truck traffic; and low rental. After the trench has been filled in, the hazards of an open trench no longer exist and formerly wasted land can be used for recreation or agriculture; acid mine drainage, a major factor in water pollution can be reduced greatly.

More locations for sanitary landfills could be found easily among the 2300 abandoned strip mines which now mar Western Maryland's countryside, and many are located near major refuse collection routes.

◆

QUESTIONS AND ANSWERS

Q - Has the use of an abandoned strip mine for disposal of solid wastes proved successful?

A - Yes. It has operated efficiently and economically for four years, at a cost of $1.50 a year for each person served.

Q - Are there any problems in operating a landfill in a strip mine?

A - Winter operation of a sanitary landfill is somewhat difficult, because it is often exposed to high winds. Sometimes it is necessary to work in a sheltered area of the strip mine to avoid the winds which scatter loose paper, and personnel must spend part of their time keeping the site clean. Attempts to catch the paper by erecting temporary fences failed. Otherwise, there are no operating problems.

Q - Has the landfill operation contributed to the pollution of surface or ground waters?

A - No evidence of water pollution has appeared to date. Tests are made continuously to observe the quality of ground and surface waters.

Landfill Project Operated by
Division of Solid Wastes
Environmental Health Administration
State Department of Health
and Mental Hygiene
in cooperation with
Allegany County
under a Grant from
Environmental Protection Agency

Produced by Educational Services
Maryland State Department of
Health and Mental Hygiene

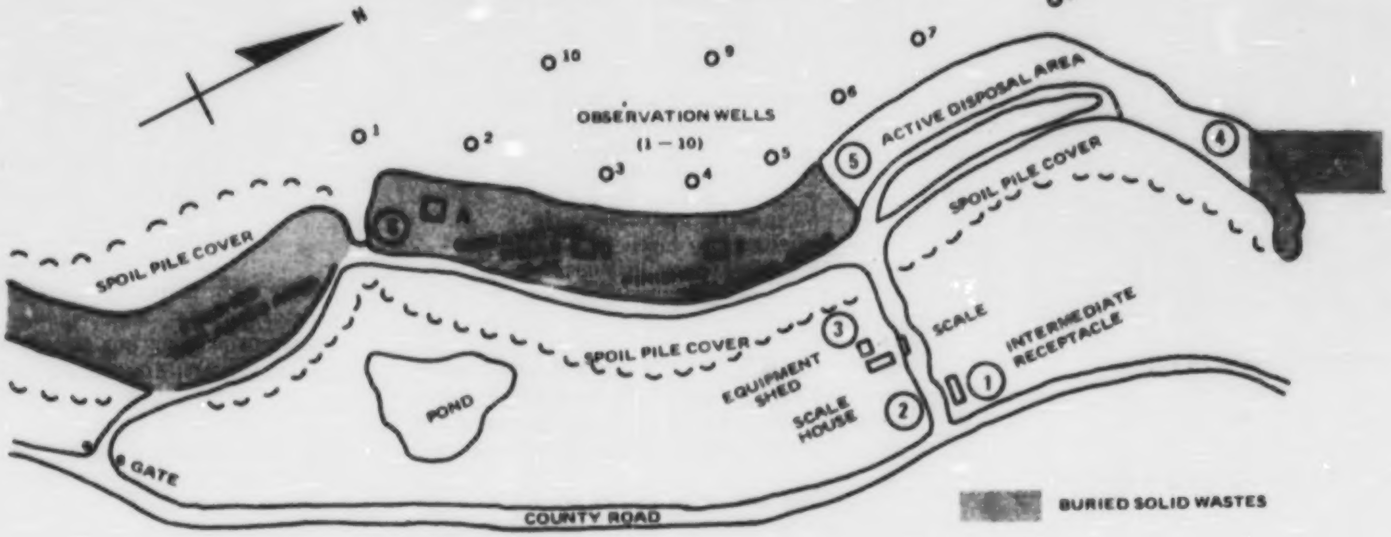
DHMH 332-1071R-1M

THE
ALLEGANY COUNTY
SANITARY LANDFILL

Frostburg, Maryland

Maryland's Bold New Approach
to
Solid Wastes Disposal

THE ALLEGANY COUNTY SANITARY LANDFILL



Intermediate Receptacle (1)

A convenient disposal area for people who have no regular refuse collection service or who have only a small amount of trash which haulers will not accept. Near the landfill entrance, it prevents accidents by keeping small vehicles out of the active disposal area. Available 24 hours a day and lighted at night.

Scale House(2)

This mobile trailer has a scale with a print-out system which records time, date, vehicle, tonnage of wastes, type and source of refuse, and weather. With this print-out equipment, actual tonnage input can be accounted for, and it provides a means to budget money on a cost per ton basis. The statistical data collected is used to schedule maintenance activities during anticipated slack periods.

Equipment Shed (3)

Stores equipment and supplies for maintenance and repairs.

Finished Reclaimed Area (4)

An average of 50 feet of compacted refuse is buried under the top soil and vegetation in this area which was graded according to the land's natural contour. It is planted with several varieties of grasses and trees to determine which will grow best. The plant cover studies are coordinated with the University of Maryland's Extension Service.

Active Disposal Area (5)

Refuse is deposited, compacted and covered with six inches of compacted earth daily. At present, 30 feet of refuse is buried here; after another 15 feet is buried, the section will be graded and planted. Vegetation used will be selected on the basis of the plant cover studies. More cover material is available from nearby spoil piles left by the mining operation.

Research (6)

Ground water observation wells (1 – 10) are in the undisturbed ground and provide a means for studying ground water movement and quality. Landfill observation wells (A, B, C) in a completed area, provide a method for collecting gasses and liquids for analysis of decomposition. Settlement pads in the finished area measure the amount of solid wastes settling which has occurred since the area was completed.

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